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A PRIZE OF ONE HUNDRED DOLLARS.

The ELECTRICAL REVIEW desires to publish an article upon the electric lighting central station superintendent—his duties, how he may best fit himself for them, what steps he must take to insure success in that profession, and what type of man is best fitted by character, experience, education and brain texture for employment under conditions of great responsibility by owners of such installations. We offer a prize of $100 for the best article of not less than three thousand nor more than five thousand words in length, received before May 1, 1901. Only articles written by members or associate members of the American Institute of Electrical Engineers, or members of the National Electric Light Association will be considered.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The forthcoming meeting of the National Electric Light Association, which will be held at Niagara Falls on May 21, 22 and 23, will doubtless be equal in interest to any of the memorable gatherings of this association and probably will possess features of novelty on account of its situation in close proximity to the Pan-American Exposition which will then be open in Buffalo.

This association is, perhaps, more representative of American methods of doing business than any other with which we are familiar. In the early days of electric lighting, when companies were springing up in various towns and cities throughout the country, each one encountered practically the same problems and each accumulated its experience slowly and painfully, in many cases going over the ground that its colleagues had already traveled. Seeing that the business of electric lighting, through its very nature, could scarcely ever be competitive—that is, that electric light companies were reasonably certain to be confined in their operations to particular districts—it was suggested that electric light men get together and hold experience meetings so that all might have the benefit of each other's knowledge of ways to overcome difficulties.

The plan was successful beyond the most ardent desires of the projectors. Each meeting has been marked with important additions to the general knowledge of the art of electric lighting, and at the annual sessions of the associations many papers of the utmost value and importance have been presented for the first time. Indeed, the technical merit of papers and discussions before this body is only second to that of the proceedings of the American Institute of Electrical Engineers.

At the annual convocations of the association are gathered together the majority of the men who have made electric lighting the great industry that it is today, and who may fairly be called captains of industry and leaders of progress. The personnel of the association is by no means the least interesting feature of the meetings.

It is believed that the Niagara meeting this year will be the most successful in the history of the association. It has generally been true that the best and most interesting meetings have been held away from the large cities, because in smaller places the members are naturally thrown more together and have less to distract them from the business in hand. The association is now in the seventeenth year of its life, and enters the new century with a vigor and activity that promise a long life full of increasing usefulness to the art which it represents.

ELECTRICITY OR AUTOPSY?

Our esteemed neighbor, the New York *Times*, seems to think that only sentimental reasons can suggest any outspoken disparagement of the present legal method of execution in New York state. Perhaps the reason is sentiment, but the sentiment is certainly one that becomes the beginning of the twentieth century as much as its absence would denote a falling back into the mental attitude of the days of the inquisition and the burning alive of witches. It is not sentimentality that demands urgently a thorough scientific investigation of this subject, unpleasant as it may be, and, if it be found that criminals executed by the electric method are not killed until the autopsy is performed upon them, then the method should be revised and overhauled or supplanted by some sure and certain variety of execution that will not possess these painful and repulsive features. Even the *Times* itself, however, feels compelled to say:

"It is, indeed, hard to understand why, if there is no doubt as to the condition of those

who have suffered the regulation shock, the criminals should now, just as when the system was new, be subjected to mutilation, which certainly kills them if they are not already dead. Nothing has been learned since the first few autopsies, and the continuance of them really looks as though a trace of official uncertainty still remained somewhere."

This is a perfectly reasonable attitude. Whether or not any official uncertainty remains as to the actual death of the victim of the electric chair it is only reasonable and proper to insist upon the appointment of some commission of experts to investigate the actual condition of the next person executed in this way to discover if he be really dead or only in a state of coma, such as many people have experienced from severe electric shock with subsequent complete recovery. It is not in the interest of the electrical profession solely, as some newspapers seem to think, that this matter is urged here, but rather in the interest of humanity which revolts at methods of execution other than the swiftest and least painful that modern science can devise.

CONSCIENCE IN ENGINEERING.

By no means all engineers realize the responsibility of the work they are called upon to do or the peculiar integrity of intention and judgment that is demanded of them in their relations with employers and contractors. It is not impossible that the promptings of conscience are sometimes stifled under the oppressive weight of custom, but there has never been more occasion than at present for the revival of conscientious effort on the part of engineers entrusted with important enterprises.

The engineer stands in the same relation to an enterprise involving constructive work or the design of plant and machinery as does the physician or the surgeon with reference to his patient. The life or death of the undertaking is in large measure in his hands, and he is the determining factor which decides the event. Nothing less than the fullest knowledge of conditions and circumstances, the most patient and complete research into all that has been done before in similar lines, and the utter suppression of personal leanings will satisfy an active engineering conscience in such circumstances. The engineer must not only feel and absolutely know his own competence, but he must approach each new piece of work with an open mind, willing to learn from the successes and failures of others the best method of undertaking the work in hand. His province is to achieve the maximum result with a minimum expenditure of effort and material—that is of other people's efforts and material. His calling is one of the highest. He must possess not only capacity for the acquirement of knowledge, but an almost infinite willingness to learn. Perhaps the best teacher that he has is the record of his own mistakes, if these are faithfully and conscientiously studied with the intention of turning them to profit.

It is not intended here to preach any homily upon the attitude of engineers, but rather to call attention to the fact that in no profession is the qualification of sincerity more essential or the possession of a lively conscience more desirable. The engineer stands between his employer and the rest of the world in a capacity of great responsibility. In most cases the employer possesses no knowledge of the technique of the undertaking in hand, and to this end employs the trained mind and knowledge of the engineer to assist him. For the time being, then, the interest of the two is identical.

It is not infrequent that engineers—men who would not for an instant think of committing a dishonest act or of assuming a responsibility in other affairs of life for which they feel themselves incompetent—will undertake engineering work involving the expenditure of much money and time, when they are consciously ignorant of what is necessary to know in order to insure success. There are few engineers who are honest enough ever to refuse a proffered commission on the ground of knowledge of their own unfitness to undertake the work. This has been the reason for many failures in important enterprises and, as a necessary sequence, of the bringing of similar enterprises under the ban of public disfavor. It is a duty to the profession at large, as well as to the individual client, that every engineer should approach a new commission with a conscientious intention of doing his utmost to further the work, or else of resigning in favor of some one better equipped than himself to carry it on. A man who would not undertake to treat a sick friend or to advise his neighbor in a lawsuit will often cheerfully accept an engineering commission involving special knowledge which he does not possess and inviting disaster.

It is not to be assumed that this condition of things is general among engineers, but this note of warning is sounded because, with increasing competition in the engineering field, men will be more and more likely to accept whatever comes their way without stopping to count the cost to themselves or others of possible failure, or without admitting even to themselves the possibility, if not the certainty, of failure when great undertakings are attempted by those ill prepared to carry them to success.

MORE SHIPS.

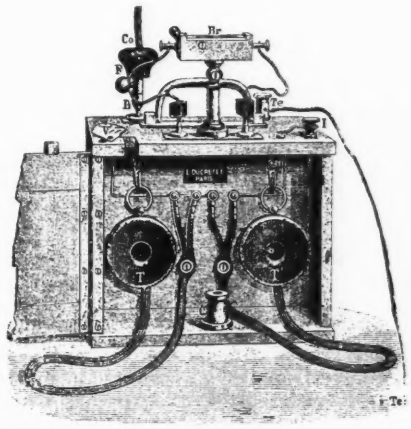
The opinion of the president of one of the largest transatlantic steamship lines running between New York, English and Belgian ports, that only nine per cent of our exports for the past three years has been carried in American vessels is worthy of the gravest consideration. Should one of the countries owning the steamship lines in which the vast majority of our goods are carried become a belligerent it would mean a practical stoppage of everything we export as carried by that line. A war between the European powers would force back upon our own markets the greater part of all that we now send abroad and the result would be so far-reaching in its character as to cause endless dismay and loss to our manufacturers. We need more American ships adapted to freight traffic. We have the men capable of constructing them, we have the materials to build them with, and we have the ability to handle such ships after they are built. Why, then, is only nine per cent of all we send abroad carried in American bottoms? When we as a nation fully appreciate this state of affairs our commerce will be made secure from loss, and our standing and prestige among the nations of the world established beyond fear of disaster.

Science Brevities

Hot-Wire Instruments — At a recent lecture before the Italian Electrochemical Association, Signor C. Olivetti enumerated the requirements to be fulfilled by a satisfactory hot-wire instrument for electromagnetic measurements in which the expansion produced by the heating is measured after amplification. Mr. Fournier d'Albe thus abstracts his conclusions: The wire should have a large temperature coefficient of expansion, a high resistance with small temperature coefficient, and a great rigidity, and it should remain unoxidized and unmodified at high temperatures. The best substance so far adopted is an alloy of two parts of silver and one of platinum. The greatest advantages of hot-wire instruments are that they are independent of magnetic fields and independent of the form of the current curve, as they work equally well with continuous and alternating currents. The author describes various windings of the wire by means of which its mechanical strength can be increased and the consumption of energy reduced.

Electrolytic Sugar—M. Dupont made known to the Congress of Chemistry which assembled on the occasion of the exposition, says *La Nature*, the results of his researches upon the extraction of different sugars by electrolysis. The electrolyzer consists of a wooden trough divided into three compartments by porous partitions made of parchment paper or porcelain or asbestos. The electrodes consist of metallic plates that vary according to the object to be attained (platinum, aluminum, lead, zinc, etc.). A current of 15 volts, and of a density of from 25 to 30 amperes per square metre of anode is employed. In order to obtain sugar from cane or beets, the saccharine juice is placed in the central compartment, and the end compartments are filled with water. Under the influence of the current, the albuminoid substances of the juice coagulate and precipitate, and the salts are decomposed. The juice becomes clear, limpid and colorless, and no longer contains anything but sugar and a few traces of organic matter plus a little lime and magnesia. By the term "sugar" is to be understood all kinds of sugar. There is no osmosis through the partitions. In the end compartments accumulate the soda, potassa and ammonia. It is possible that the process studied by M. Dupont may be applicable industrially. The future will inform us as to that. But, however, that may be, it is already very advantageous as a means of analysis. It permits, in fact, of rapidly searching for, isolating and making a quantitative analysis of the various sugars that may exist in a large number of plants.

Telephonic Receiver for Space Telegraphy—MM. Popoff and Ducretet described recently, before the French Academy of Sciences, a receiver which dispenses with a relay and a decohering device, the messages being read by means of a telephone receiver. The apparatus, of which the illustration is reproduced from the *Electrician*, is very portable. B *r* is the coherer, filled with grains of hard carbon or other substance, which can be given any inclination. During transport it is mounted in the block C. C *o* is the air wire, which need only be a couple of feet long if there is a good earth connection at T *e*. Dry cells are used for the circuit. T'T' are the telephones. The apparatus is exceedingly sensitive.



TELEPHONIC RECEIVER FOR SPACE TELEGRAPHY.

Electrolytic Recovery of Gold – The Rieckan process for the recovery of gold from sulphide and telluride ores is now stated to be working successfully in Western Australia. Iron tanks are employed, these being 11 feet deep, 12 feet long and eight feet wide, and lined with removable copper sheets. There are two such tanks which are capable, jointly, of treating 60 tons of material per day. The operation consists in agitating the prepared products in the tanks with a dilute solution of cyanide, and conducting through the vat a current of electricity, which deposits the coarse and fine gold as an amalgam that can be converted into marketable form with a minimum of expense and loss. The advantages of the process are stated to be that the gold is recovered in one operation, no after process being required, and the bullion, on account of its purity, demands a high price.

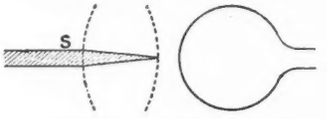
Stratification of Discharges—The luminous portions of a stratified discharge are those in which the number of ions per unit volume is a maximum, while it is a minimum in the dark portions. On the anode side of each bright stratum there is a positive surface charge, and on the cathode side there is a negative surface charge. At the electrodes there is a diminution of ionization by electrolysis, and this diminution is particularly great at the cathode in consequence of the difference in the velocities of the positive and negative ions. In the dark spaces the forces driving the ions are greater than in the bright strata. They are greatest at the cathode. This implies a corresponding variation of the potential gradient. Herr J. Stark sketches, in a German contemporary, the production of stratification as follows, according to an *Electrician* abstract: As soon as the discharge has been started the difference of velocity between the two kinds of ions produces a reduction of the ionization and hence also of the force at the cathode. The negative particles acquire a great velocity and retain it for considerable distances owing to ionic shooting. The negative glow light is a region of strong ionization, which reduces the velocity of the negative ions and produces an accumulation of them just beyond it. That accumulation acts as a secondary cathode, and produces similar phenomena.

Efficiency of the Acetylene Flame—Experiments carried out at Cornell University by Professor E. L. Nichols show that the total efficiency of the acetylene flame is superior to that of any other, except the magnesium flame. The total efficiency is compounded of the luminous and the thermochemical efficiency. The luminous efficiency is the percentage of the total radiation which consists of visible light. That percentage is 1.5 in the paraffin candle, 2.6 in the oil lamp, 1.2 to 2.4 in the gas jet, 5 to 6 in the glow lamp, 2 to 7 in the incandescent gas lamp, 12.5 in the magnesium band, and 32 in the vacuum tube. The arc light has a luminous efficiency of 10.4 and the acetylene lamp of 10.5. The thermochemical efficiency of the acetylene lamp (*i. e.*, the ratio of radiation calories to total calories due to chemical combination) is 0.225. Hence the total efficiency is $0.225 \times 0.0105 = 0.0236$. Another experiment carried out with a larger flame ("normal" size) gave 0.0190. This is at least double the total efficiency of the arc light, though,

of course, this total efficiency has nothing to do with "financial" efficiency or cheapness. Otherwise the magnesium light, with its wonderful efficiency of 0.1025, would be the cheapest source of light.

False Spectra—Mr. Theodore Lyman contributes to the *Physical Review* the results of his experiments on false spectra which can be obtained from the Rowland concave grating. To give the conclusions first, he finds from experimental evidence that (1) the first spectrum produced from the Rowland concave grating is not pure, but is complicated not only by underlying spectra of higher order, but by the presence of a number of spectra of lower dispersion than the chief spectrum; (2) the number and dispersion of these false spectra obey no simple law; (3) the number, dispersion and clearness of these spectra differ with different gratings; (4) the lines due to the false spectra are most clearly visible in the extreme ultra-violet owing to the absence of strong real lines, and are so pronounced as to screen the feeble real line that may occur in this region. In explanation of these conclusions, the author states that it seems probable that in developing the theory of the grating some assumptions have been made which are not according to fact. It is in the error of such assumptions that we must seek the solution of the problem. It is generally assumed in treating the grating that the lines of the ruling are of equal width, and are separated by equal spaces. In the very nature of things it is evident that this can not be the case, in view of the very minute distances involved and the almost inconceivable rigidity of the ruling engine which would be necessary. These variations, slight in absolute amount, may be a considerable fraction of the distance from line to line. It is clear, moreover, on experimental as well as on the theoretical ground, that these variations are not local, but extend over the whole surface of the grating. It appears, then, that the departure from equal spacing assumed in the theory of the concave grating is not the random departure which is next in theoretical simplicity, but a more or less systematic departure which has emphasized disproportionately certain of the subordinate maxima called for in the conventional theory. If the position of the false maxima occurred in the ratio 1 : 2 : 3, or in any other simple ratio, the phenomena would invite an analytic discussion. As an experimental fact, however, our lines are not harmoniously placed with respect to the slit, nor are they arranged according to any discoverable system. Moreover, they are different in character and position when obtained by different gratings ruled by the same engine. It seems most likely that the phantom lines are due to a number of superposed first spectra of varying dispersions, and that these false spectra owe their existence in some manner to the variation in width and separation of the grating lines. The author, says the *Electrical Engineer,* also adds that gratings of large radius do not show the false lines with as much clearness as gratings of small radius. So feeble indeed are the false lines obtained with the 21-foot grating that it is improbable that they would be noticeable in ordinary spectrum investigations. It is possible, apparently, to predict the nature of the false spectra of one grating from the false spectra produced by another of the same ruling and radius.

Perforation of Glass Bulbs—Herr V. Dvorák has discovered a simple and safe method of perforating thin-walled glass bulbs, says the *Electrician.* Take



Perforation of Glass Bulbs.

an electric-light carbon S (see figure) about four millimetres thick, introduce its point into a blow-pipe flame, and place the bulb beside it. When the point is white hot push it softly, with slight torsion, into the bulb, and retract it at once. The small opening thus created has a rim projecting inside, and does not produce cracks. A bulb can thus be perforated like a sieve, and it does not crack for months.

Charges due to Roentgenized Air—Herr E. Dorn, writing in the *Physikalische Zeitschrift,* attempts to explain Villari's curious observation that Rœntgenized air (air which has been exposed to X-rays) charges metallic bodies positively when it impinges upon them with force, and negatively when it touches them lightly. The author's explanation is based upon the difference in the velocities of the two classes of ions, says the *Electrician.* When the ionized air flows past a metallic surface without perceptible friction, the negative ions are, owing to their swifter motion, the only ones which will touch the surface to any great extent. When there is strong friction, with rapid changes of direction of motion over small distances, the superior mass of the positive ions will enable them to retain their direction of motion to a greater extent than in the case of the negative ions. This differentiation is assisted by the fact that in gases under ordinary pressure the mass of both kinds of ions is much greater than the mass of the unionized molecule. The mixture of the three classes of particles may be compared with that of stone blocks of two sizes, mixed with sand, and allowed to slide down an inclined plane.

Permanency of Magnets—In a paper in the *Annalen der Physik* Herr I. Klemencic has pointed out that magnets which show the greatest permanency when exposed to shocks and jarring do not possess high resisting power against other demagnetizing influences. Magnets should be tested, he thinks, with the same patience as our standard cells and their examination should occupy a corresponding interval of time. Experiments extending over a whole year showed him that a magnet which in the first 27 days was placed near the end of the series of permanency was advanced to the first place in the course of subsequent tests. In general, he concluded that those magnets are most permanent in which the ratio of length of cross-section is great. Decrease in the magnetic moment is particularly great within the first few days after magnetization, after which it becomes slow.

X-Rays in Tuberculosis—A medical contemporary reports the following experiments by Dr. J. Rudis-Jicincky: Tuberculous sputa were sealed up in fish bladders along with a suitable nutrient medium and then submitted to the rays. In general it was found that the action of the rays was destructive to the tubercle bacillus when in acid media. A series of experiments was then made on rabbits and guinea pigs, the animals being subsequently exposed to the rays. In 40 per cent of the animals thus treated, and killed after the lapse of two years, autopsy showed that actual cure, in the real sense of the word, of the tuberculous process had occurred when the acid condition was produced. Finally, the author treated 20 cases of pulmonary tuberculosis with the X-rays. Of these one patient died within the year from tuberculosis of the bowel, another committed suicide, four were without improvement, while the remainder were doing comparatively well at the time of the report. The author does not conclude that the results were necessarily the consequence of exposure to the rays, for he utilized to the utmost good food, fresh air and hygienic surroundings. He feels encouraged, however, to continue his researches along this line.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XX.

BY W. ELWELL GOLDSBOROUGH.

By way of a recapitulation let us review the circuit just discussed in a little different light. Suppose we consider the constant electro-motive force E impressed on a series circuit of

moderate resistance r,
infinite inductance L,
and infinite capacity C.

The vector diagram of this circuit is shown in Fig. 56. Suppose now that (r) and C are kept constant and L is gradually reduced to zero. With the reduction of L a current appears in the circuit which changes both in value and phase position, its vector head following the locus indicated in Fig. 57. When L equals zero the current has reached the phase of the impressed electro-motive force and a maximum value as long as (r) is constant. With the inductance L eliminated suppose the capacity C to be gradually decreased from its infinite value to zero. With the reduction of C the current moves away from the impressed electro-motive force. Its vector head passes forward along the locus circle and with a decreasing value moves towards a position 90° in advance of OA. When, finally, the capacity also is reduced to zero the current disappears from the circuit and the vector diagram is reduced to the form of Fig. 58, which is the vector diagram of a series circuit of

moderate resistance r,
zero inductance,
and zero capacity.

In Fig. 57, free from all other factors, we have the current vector phase diagram for variable reactance and constant resistance. The current is proportional to the resistance electro-motive force of the circuit, with which it is also in phase. Therefore, since the power developed in any alternating-current circuit is proportional to the product of the working component of the impressed electro-motive force and the current, and since in this circuit E_r is equal to this working component, we have

$$P = \bar{E}_r \bar{I} = \bar{I}^2 r,$$

or the power developed in the circuit is proportional to the square of the current, (r) being constant. The value of this power is shown in Fig. 55 by the vector OP, the length of which is determined by the intersection of the current vector OB with the curve $OP_l PP_c O$.

Since the current is a maximum when the reactance of the circuit zero, *i. e.*, when $L = 0$ and $C = \infty$, the power is a maximum at the same time. This may be mathematically demonstrated by taking the first differential of the power equation with respect to (x) and equating it to zero, a procedure which gives the value of (x) for which P is a maximum. Differentiating (182)

$$\frac{dP}{dx} = -\frac{2\bar{E}^2 r x}{(r^2 + x^2)^2} = 0$$

from which

$$x = 0$$

Now when $x = 0$, by (146), the tangent of the angle of phase difference between the current and the impressed electro-motive force is equal to zero, or the angle of phase difference of the current is zero when the dissipation of energy in the circuit is a maximum.

Furthermore, the power locus loop is

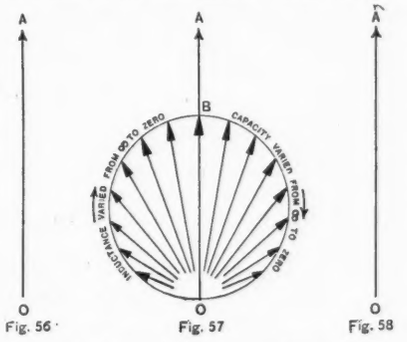


Fig. 56 Fig. 57 Fig. 58

FIGS. 56-58. – ALTERNATING-CURRENT MECHANISMS.

symmetrical about the vector of maximum power.

We have the rule, therefore, that

The power developed in an alternating-current circuit of constant resistance is a maximum when the effective reactance of the circuit is zero.

Example No. 12.

An electro-motive force of 60 volts at 30 cycles is impressed upon a circuit containing a variable reactance connected in series with a line having a fixed non-inductive resistance of 1.5 ohms.

Determine the values of the reactance of the circuit, the current and the power developed in the circuit, when the reactance variations are such as to cause the phase of the current to vary from a position 90° behind the impressed electro-motive force to a position 90° in advance of it by successive increments of 10° each.

Since by equation (55)

$$\phi = \tan^{-1}\frac{x}{r}$$

When the resistance of a circuit is constant the value of the reactance in terms of the resistance and the angle of phase difference between the current and the impressed electro-motive force is expressed by the equation,—

$$x = r \tan \phi. \qquad (186)$$

Moreover, when the value of the reactance of a circuit is known, as well as the value of the resistance of the circuit, and the electro-motive force impressed upon the circuit, the value of the current flowing is given by the equation,

$$\bar{I} = \bar{E} \div z$$

and the power developed in the circuit by equation (91),

$$P = \bar{E}\ \bar{I} \cos \phi.$$

If now, by the substitution in (186) of successive values of ϕ in accordance with the requirements of the problem, a series of values of (x) are determined, the corresponding values of $\bar{I}$ and P are readily found.

Following through these substitutions the values tabulated in Table 4 result, and by plotting them, Fig. 55 was obtained. The dotted radial lines show the relative positions of the tabulated values, as the dotted lines cut the curves at points the radial distances of which from the centre are proportional to the numerical values.

The point of maximum power, as illustrated, falls on an extension of OA and is equal to 2,400 watts.

TABLE 4.

ϕ_l	$\tan \phi_l$	x_l	$\bar{I}_l$	$\cos \phi_l$	P_l	ϕ_l
90	∞	∞	0	0	0	90
80	5.671	8.506	7.0	.174	74	80
70	2.748	4.122	13.7	.342	282	70
60	1.732	2.599	20.0	.500	600	60
50	1.192	1.788	25.7	.643	991	50
40	.839	1.259	30.6	.766	1,402	40
30	.577	.865	34.6	.866	1,798	30
20	.364	.546	37.6	.940	2,120	20
10	.176	.264	39.4	.985	2,326	10
0	0	0	40	1.000	2,400	0
ϕ_c	$\tan \phi_c$	x_c	$\bar{I}_c$	$\cos \phi_c$	P_c	ϕ_c

ON CIRCUITS OF CONSTANT REACTANCE IN SERIES WITH CIRCUITS OF VARIABLE REACTANCE.

In alternate-current working cases frequently arise in which circuits, consisting for the most part of elements having constant resistances and reactances, contain other elements having variable reactances. The circuit diagrammatically illustrated in Fig. 59 is one of this type. Here an electro-motive force E is impressed upon the circuit OA_1, consisting of a variable inductive reactance L_1 in series with a constant non-inductive resistance r_1, and the circuit A_1A, consisting of the constant inductive reactance L_2. The impedance of the circuit OA_1 is variable, that of the circuit A_1A constant. We may assume initial conditions by which L_1 is very large. In this case the impedance of the system is such that the current set up by E is very small. As L_1 is gradually reduced, the impedance of the system will decrease and the cur-

rent increase, a set of conditions thereby obtaining in the system that are analogous to those discussed in connection with Fig. 55. For if, in Fig. 62, OA be laid off equal to E, we can construct on it the triangle of electro-motive forces consequent to the known values of r_1 and L_2 and an assumed instantaneous value of L_1. OC_1A is such a triangle. In it OC_1 is equal to $I_1 r_1$, C_1A_1 is equal to $I x_1$, and A_1A is equal to $I x_2$. All of these vectors, however, vary in length as the value of L_1 is varied, since their lengths depend upon the value of the current, and the value of the current depends upon L_1. Between the limiting values infinity and zero of L_1, as L_1 varies the system as a whole reduces to one having a constant resistance and a variable inductive reactance connected in series. The heel C_1 of the electro-motive-force triangle OC_1A will then progress along the curve OC_1C_2C as L_1 diminishes, since the curve OC_1C_2C is part of the circumference of a circle of which OA is the diameter. If a new value is given to L_1 the heel of the electro-motive-force triangle will move up

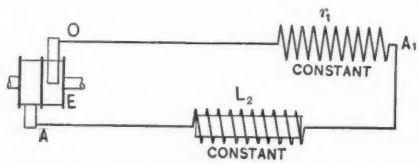


FIG. 60.—ALTERNATING-CURRENT MECHANISMS.

to the point C_2, and as r_1 is a constant the current vector will increase along a similar curve up to B_2, since

$$OB_2 = OC_2 \div r_1.$$

Further than this, since L_2 is a constant, x_2 is also constant, and the reactance electro-motive E^1_x force of the circuit A_1A, Fig. 59, must, accordingly, increase proportionally to the current since it is equal to $I x_2$. The value of E^1_x corresponding to the diminished value of L_1 can, therefore, be obtained by the proportion

$$OC_1 : OC_2 :: OB_1 : OB_2 :: A_1A : A_2A.$$

But C and B move along loci which are parts of the circumferences of circles of which the points O_e and O_i are respectively the centres, therefore A_1 also has a locus that is a part of the circumference of a circle; for since the angles AC_1O and AC_2O are right angles, the angles C_1OC_2 and C_1AC_2 are equal, and therefore the areas AA_1A_2 and OB_1B_2 are similar, and the arc AA_1 is the arc of a circle.

If L_1 is further diminished C_2 will continue to move up along the curve OC_1C_2, and A_2 will continue to move down along the curve AA_1A_2; and when, finally, L_1 is reduced to *zero*, the curves OC_1C_2 and AA_1A_2 will intersect at the point C. When this occurs the vector diagram takes the form of the electro-motive-force triangle OCA, a triangle representative of the forces acting in a simple circuit of constant resistance r_1 and constant inductance L_2. In the latter case OB represents the value of the current when $L_1 = 0$.

In this connection it is especially interesting to note the change in the potential acting on the circuit OA_1, Fig. 59, as L_1 is reduced. When L_1 is very large this potential approximates the value of E, but as L_1 is made smaller and smaller, the potential acting on OA_1, Fig. 59, first diminishes and then increases. For the pressure required to overcome the impedance of the circuit OA_1 must always be the resultant of the resistance

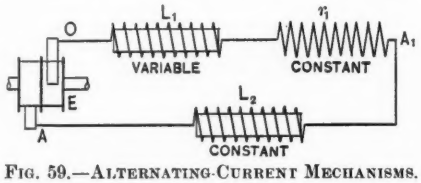


FIG. 59.—ALTERNATING-CURRENT MECHANISMS.

electro-motive force $I r_1$ and the reactance electro-motive force $I x_1$, and this resultant is shown by Fig. 62 to be successively OA_1OA_2 and OC, corresponding to the several values assumed for L_1. By the geometry of the figure the vector OA will be least for that value of L_1 which gives it such a phase position that its extension passes through the centre O^1_e of the locus circle AA_1A_2C. It is therefore a minimum in the position OA_2 and increases on either side of the point A_2. In the present case OC is equal to 85 per cent of OA, while OA_2 has only 74 per cent of the value of OA_2.

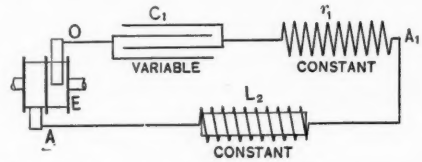


FIG. 61.—ALTERNATING-CURRENT MECHANISMS.

In determining the position of the locus circle AA_1A_2C, the vector OC is extended until it intersects the line AK, passing through the point A at right angles to OA. On AK as a diameter the locus circle is described from the centre O^1_e.

When L_1 is reduced to *zero* the circuit shown in Fig. 59 assumes the form shown in Fig. 60. The vector diagram of this circuit is the electro-motive-force triangle OCA, which is common to Fig. 62 and Fig. 63. The current in this circuit has the value OB.

The town council of Culpepper, Va., is said to be considering an electric light plant, and is soon to ask for bids.

The Marconi Patents Upheld.

A decree has been signed by Judge Alfred C. Coxe, in the United States Circuit Court, New York city, dismissing the complaint brought by L. C. Learned against Guglielmo Marconi, and which seems to end the long-standing dispute over the validity of the wireless telegraph patents obtained by the latter. The complaint was filed October 17, 1899. The plaintiff, Mr. Learned, contended that wireless telegraph apparatus was invented by A. E. Dolbear in 1882, and that the patents came into his possession on July 22, 1899. He further contended that in

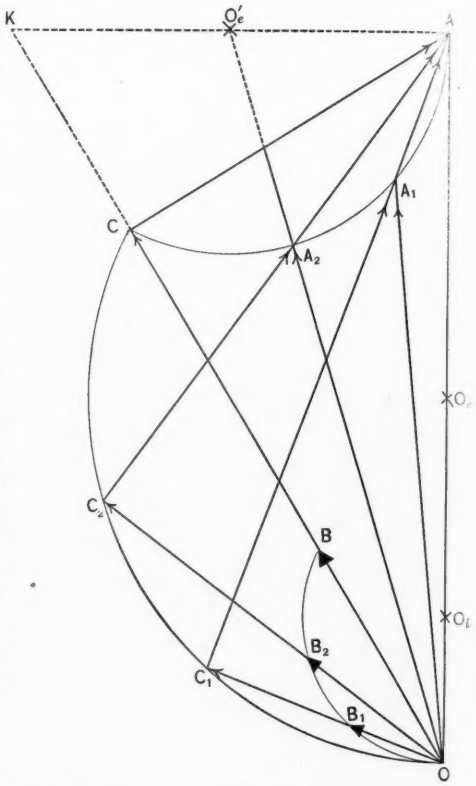


FIG. 62.—ALTERNATING-CURRENT MECHANISMS.

reporting the international yacht races in 1899 Marconi had infringed some of the Dolbear patents.

A considerable amount of expert testimony was taken in the case. Dr. John A. Fleming, of London, testified that he had experimented with apparatus constructed under the specifications of the Dolbear patent, and failed to obtain results. He furthermore testified that Marconi's apparatus depended for its action upon the production of electric waves, the essential element used for this purpose being the spark gap; this is entirely absent in the Dolbear arrangement.

It is believed that other patentees of wireless telegraph systems were interested with Mr. Learned in his suit, and that the outcome of the action virtually establishes the validity of Marconi's patents. It is said that Mr. Marconi is greatly pleased at the decision.

The Schenectady Works of the General Electric Company—III.

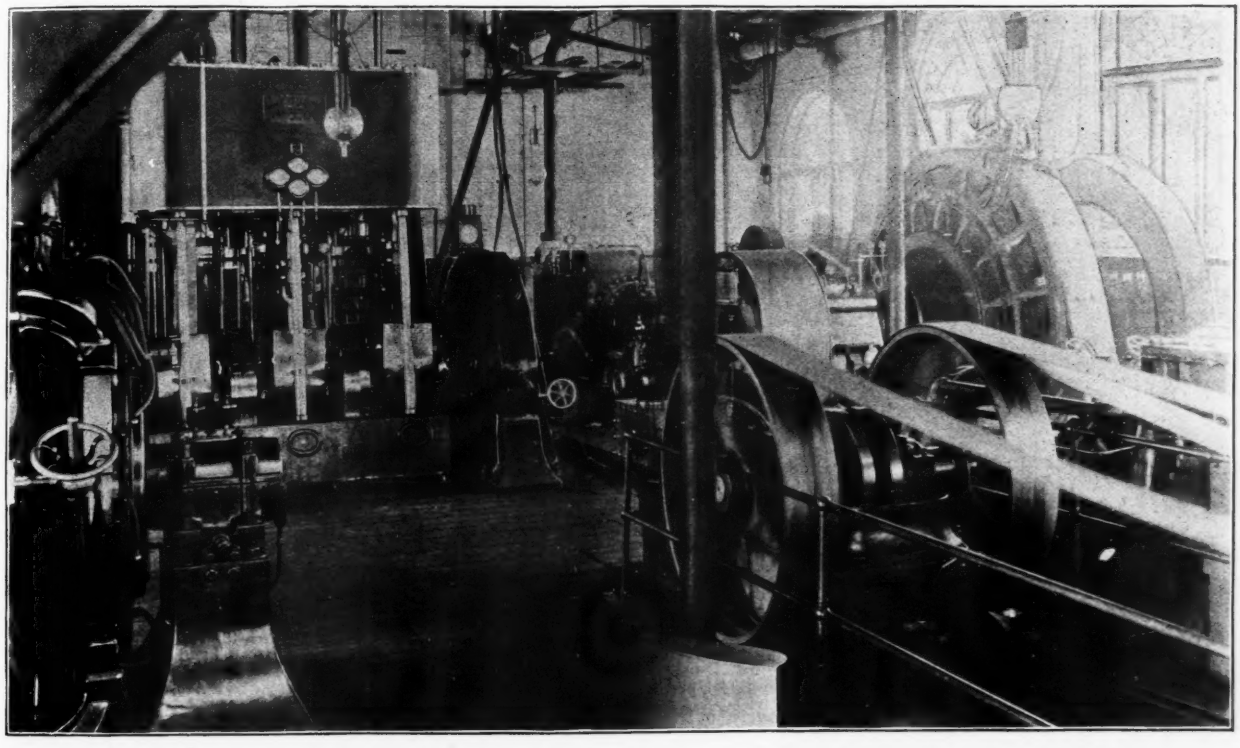
The Largest and Most Complete Electrical Manufacturing Establishment in the World—Some Account of Men, Methods and Machines—A Representative American Industry.

Notwithstanding the great extent of the General Electric Company's works and the vast diversity of industries which are gathered together in them, a singular coordination is noticeable, and the operation of all the various departments is carried on in such a way that the works may be regarded as a unit. This view of the establishment is most interesting, especially as showing how the managing authorities have gathered together the various threads of their great fabric and woven them into a complete whole, each part being, in a way, dependent upon all the others, and all working together for the production of the common product.

One of the essential features of the whole establishment is the central power plant, from which is transmitted, electrically, power for the operation of the entire works. This plant is steam-driven, in part, and in part consists of a substation receiving power from the falls of the Hudson River at Mechanicville, some 19 miles away. The illustrations show a portion of the steam-driven plant and the receiving transformers and rotaries, which convert the Mechanicville current into the necessary variety for distribution.

At the present writing the steam plant is undergoing extensive alterations and enlargements. On the left in the illustration is shown one of the types of engines which has been used for some years past—vertical triple-expansion machines driving a dynamo at each end of the engine shaft. There are now being erected three of the large engines shown on the right, these being of a horizontal tandem-compound type, the dynamo being located between the two parts of the engine. All of the current generated in this plant, to the amount of 3,500 kilowatts, is direct current and is distributed over the works on a three-wire system, having 250 volts between the outside wires.

A very interesting feature of the power plant is the rotary converter and transformer installation, whereby the Mechanicville current is received and converted. As the illustration shows, there are 12 transformers receiving and reducing the line current, and four rotaries converting it to direct current and feeding it to the general distribution system in multiple with the steam plant. The arrangement of this portion of the generating, or rather we should say the current-supply station, is exceedingly simple and convenient, as may readily be seen from the illustration. The rotaries employed are of a 10-pole type, having a maximum capacity of 500 kilowatts, and are fitted with a highly ingenious mechanical contrivance for producing end-wise play of the shaft. It will be noticed that the near end of the shaft of the nearest rotary shown in the illustration is covered by a cap. Inside this cap is a raceway in which runs a small steel ball, this raceway being slightly inclined to a plane perpendicular to the axis of the shaft. The armature of the rotary is so placed that the pull of the fields tends to throw it toward this end-plate, but the ball, catching between the end of the shaft and the inclined groove, runs around and



PART OF THE STEAM-DRIVEN CENTRAL POWER PLANT OF THE GENERAL ELECTRIC COMPANY'S SCHENECTADY WORKS.

causes the armature to be forced backward a short distance, when the magnetic pull again brings it toward the plate. In this exceedingly simple and satisfactory way the rotary armatures are given a steady end play of about one-quarter of an inch.

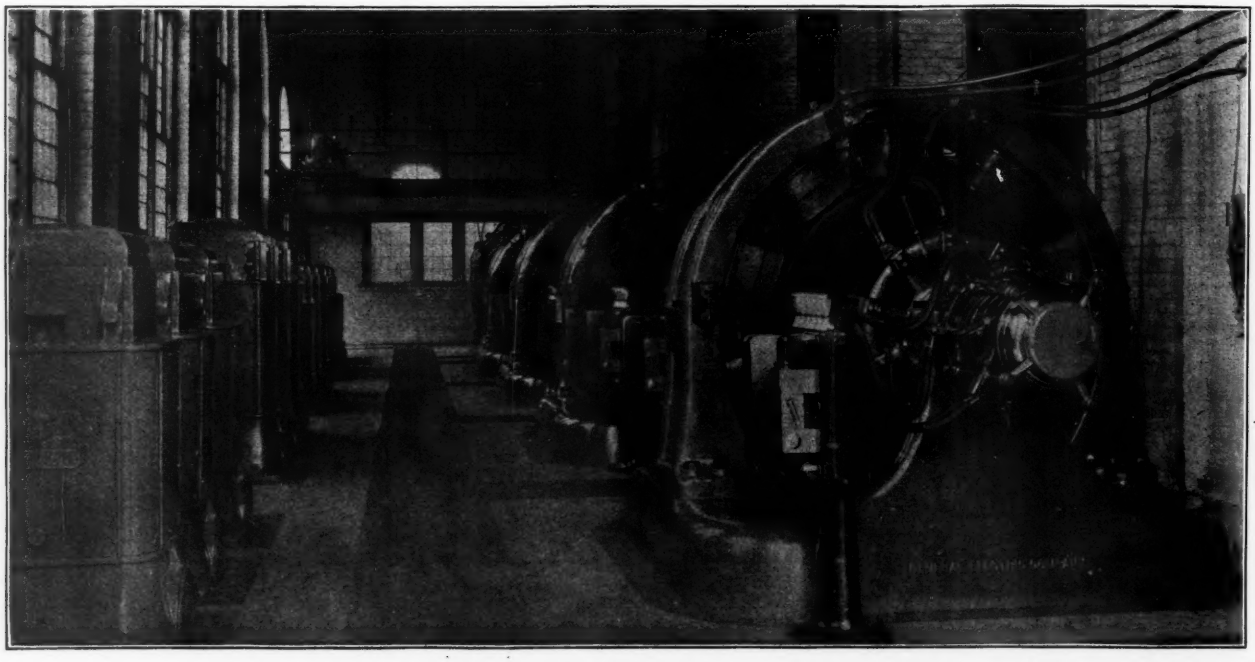
From this plant is distributed current for the operation of the various shops for lighting and for testing. The latter is one of the most important features of the General Electric Works, and probably nowhere else in the world is a more elaborate system in vogue, nor has the product been more carefully studied to find out precisely its constants and quality; nowhere has it been more rigorously brought to fulfill the rigid specifications under which the majority of it is built. One of the illustrations gives a general view of the testing department in building No. 11, which is one of the machine-shop buildings. The larger machines, however, and some of the small ones as well, are tested in one end of the great machine-shop building No. 16, so that really only a portion of the outfit for testing is here exhibited.

To go into any detailed description of the testing operations carried on in these shops would amount, virtually, to writing a treatise on the art of machine operation under most difficult conditions. Let it suffice to say that every machine is put through a practical test, and that there has been kept for a long time, among the records of the engineering department of the works, very accurate and skillful observations of the performance of every machine made under all conditions possible to apply to it without doing it injury. The result of this is what may be regarded as the most complete set of accurate observations upon electrical machinery ever assembled together, a series of data of practically inestimable value to engineers engaged either in new designs or in the perfection of standard designs already manufactured. Some of the processes of testing are of great interest; for example, in the armature department, armature coils are tested for short-circuits by placing them on a slotted core, upon which are lowered the two poles of an inverted U-shaped laminated magnet energized by alternating current. This makes the coil for the moment the secondary of a transformer, and any short-circuit existing in it becomes evident promptly by the singing noise and smoke due to heating. Insulation for large alternators is given a prolonged test under high potential to discover any sign of weakness that may exist in it.

The regular standard direct-current generators and motors are generally tested by driving them in pairs, one as a dynamo and one as a motor, or driving them up to load and absorbing their output, either by means of fans when the machine happens to be a motor, or by a water rheostat when it happens to be a dynamo.

Of course, some of the larger apparatus can not conveniently be driven up to its full power but it is not difficult to test it, under what are practically service conditions, by applying tensions in excess of those normal to the machine for the testing of insulation, and then by passing currents of great volume through its coils to observe the heating effects. For the purpose of generating such currents the shops are provided not only with transformers of large output at low voltage, but as well with direct-current dynamos giving enormous current at a few volts.

An elaborate system of records is made from each test, and these having been worked over and tabulated, or plotted, by the engineering department, become the basis for exceedingly valuable records showing the performance of the apparatus manufactured. Perhaps the most important property that the company possesses is this long record of tests of apparatus, because it is the basis upon which all the future work of its engineering department must necessarily be built, and is, furthermore, a sure basis of fact gathered from actual observation.



THE TRANSFORMERS AND CONVERTERS RECEIVING CURRENT FROM MECHANICVILLE AT THE GENERAL ELECTRIC COMPANY'S SCHENECTADY WORKS

From the testing room machines go to the shipping department, which is well illustrated in one of the engravings. The arrangement permitting box and flat cars to be brought in under the traveling cranes, by means of which the pieces to be shipped are handled, is so evident from the illustration as to make description unnecessary.

Turning, now, for a moment, from the works themselves to the headquarters of the management, there is no better way

to understand the magnitude of the work of the engineering department than by a glance at the two illustrations showing the draughting room. These were taken by a camera placed near the centre of the room, which was turned first one way and then the other, and give a fairly good idea of this enormous room in which over 250 draughtsmen are normally at work every day. In connection with this draughting room is operated probably the largest blue-printing establishment in the country, the peculiar requirements of an electrical engineering manufactory making a very large number of blue-prints necessary. By an ingenious contrivance, consisting simply of a number of arc lamps enclosed in a parabolic sheet metal reflector which may be lowered over the printing frame, the company's draughtsmen have rendered themselves independent of daylight, and can make blue-prints in dark weather or even at night, with an exposure of six or seven minutes. It may be mentioned here, also, that the company has an elaborately equipped photographic department housed in a building provided with skylights and side lights, and also a railroad track through it so that large apparatus on cars may be brought in and photographed. The photographs illustrating this series of articles were made by this department of the works.

The office force proper is housed for the present in temporary quarters, but will soon occupy a five-story office building which will be erected on the main street of the works just to the east of the present pattern shop and drawing room. In this office force is comprised not only the executive and clerical departments of this great establishment, but also the engineering department. It is hardly necessary, in a paper of this character, to speak of this department of these works, or of its personnel. It includes some of the best known engineers in the United States, and nothing can better exemplify their work than the magnificent industry which has been in part and briefly described in the foregoing pages.

Next to the air of industry which pervades the establishment, and to the sense of completeness which the visitor carries away with him, perhaps the most striking feature of all is the evident care which the company has given to the comfort and health of its employés. A notable neatness pervades the grounds and buildings, and the illustrations show better than any description how well lighted are the different workshops. Ventilation has been cared for very particularly, and the sanitary condition of the whole establishment is of the very best. One of the illustrations, showing a washroom with wire netting lockers for the use of the men, gives an idea of the neatness and perfection of such arrangements throughout the buildings. As the works are situated at some distance from the centre of Schenectady, a great number of the employés of all grades use bicycles in going to and from the shops, and near the gate-house the company has provided extensive bicycle sheds where about 2,100 wheels are cared for during the day while the owners are at work.

Throughout the works, wherever this has been possible, the system of piece-work payment has been adopted. The standardization of product, so thoroughly practised, has made possible a very wide extension of the piece-work system, so that to-day, of the payroll for men below the grade of foremen—that is, for the actual mechanical operatives employed—it is stated that over 85 per cent goes to payment for piece work. This system has received its highest development in American shops, and has been one of the factors most productive of pleasant relations between manufacturer and employé.

It is no easy task to attempt an estimate of the importance of such an industry as has been hurriedly sketched in these papers. In attempting to measure the total output that this magnificent establishment has turned out it runs into meaningless figures, either when expressed by the total

PART OF THE TESTING DEPARTMENT IN BUILDING NO. 11 OF THE SCHENECTADY WORKS.

value of the product in money, or by any expression of the amount of power it has made available to the uses of industry and civilization. Employing, as these works do, nearly 8,000 persons, and an

THE SHIPPING DEPARTMENT OF THE SCHENECTADY WORKS.

effective working power of machines representing about four times the total output that this army would have were it working in the old-fashioned way by hand, the works are turning out constantly apparatus which enables the better utilization of natural forces, the distribution of power and light, and which represents the highest development of engineering skill and mechanical and electrical science. The company's product, far from being ephemeral and a thing subject to consumption and disappearance, becomes, in its turn, the nucleus of other industries, giving employment to countless numbers of people and adding sums almost incalculably disproportionate to its actual value to the general wealth of the body politic. It is precisely such manufacturing institutions as this, belonging to the various great industries of the mechanical variety, that have given this country its sure preeminence in the industrial arts. No description of these works should be closed without a recognition of the superb work of the men, true "captains of industry," who have made such an establishment possible, and who are maintaining it to-day at the highest standard of efficiency and completeness.

The Memphis, Tenn., Telephone Company recently fixed its capital stock at $200,000, and was incorporated to carry on a local service and maintain connections with long-distance companies. The incorporators are W. A. Percy, W. P. Richardson, T. R. Reddick and others.

Wall Street and the Electrical Stock Market.

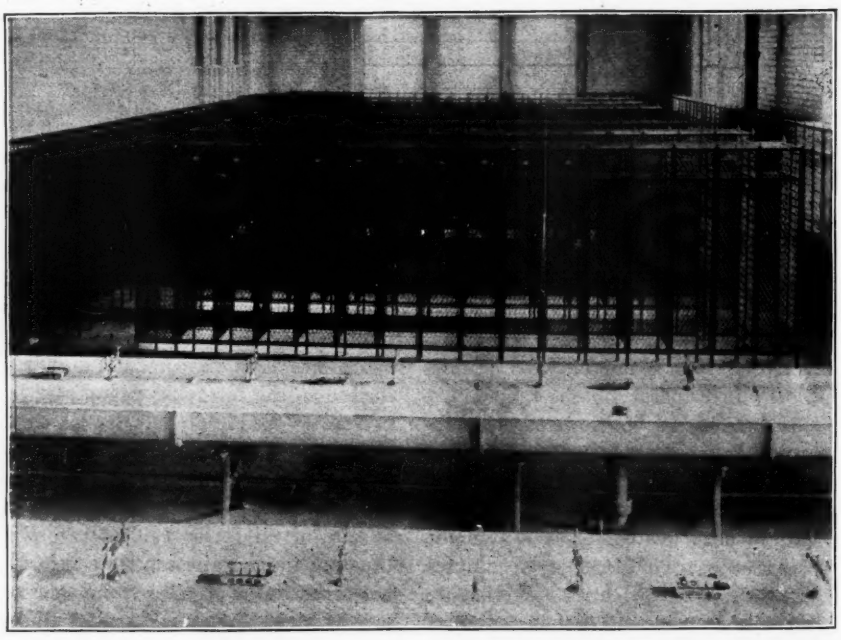
On the New York Stock Exchange, General Electric closed the week at 214 bid and 215 asked, showing a gain of 4 points. It is reported that General Electric directors have informally decided to authorize a stock dividend at the annual meeting in May, giving one share for three, and to increase the dividend rate to 10 per cent. The annual report is said to be about completed, and will show a gross business of $32,000,000, with net profits upwards of $7,000,000, or about 32 per cent on capital stock. Metropolitan Street Railway, of New York, closed at 163¼ bid and 163⅜ asked, showing a loss of 4 points. Brooklyn Rapid Transit closed at 82¾ bid and 82⅞ asked, indicating a gain of ½ point for the week. Third Avenue Railroad closed at 121½ bid and 123 asked, indicating a gain of ½ point for the week. Manhattan Railway, of New York, closed at 125¼ bid and 125½ asked, showing a gain of ¼ point.

On the Boston exchange, American Telephone and Telegraph closed the week at 168 bid and 168½ asked, showing a gain of 9 points. Erie Telephone closed at 49 bid and 50 asked, indicating a loss of 4 points for the week, and a loss of 6½ points in the last two weeks. New England Telephone was quoted at 139 bid and 140 asked.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed the week at 8⅝ bid and 8¾ asked, showing a gain of ⅜ point. Union Traction closed at 30¾ bid and 30⅞ asked, showing a gain of ⅜ point for the week.

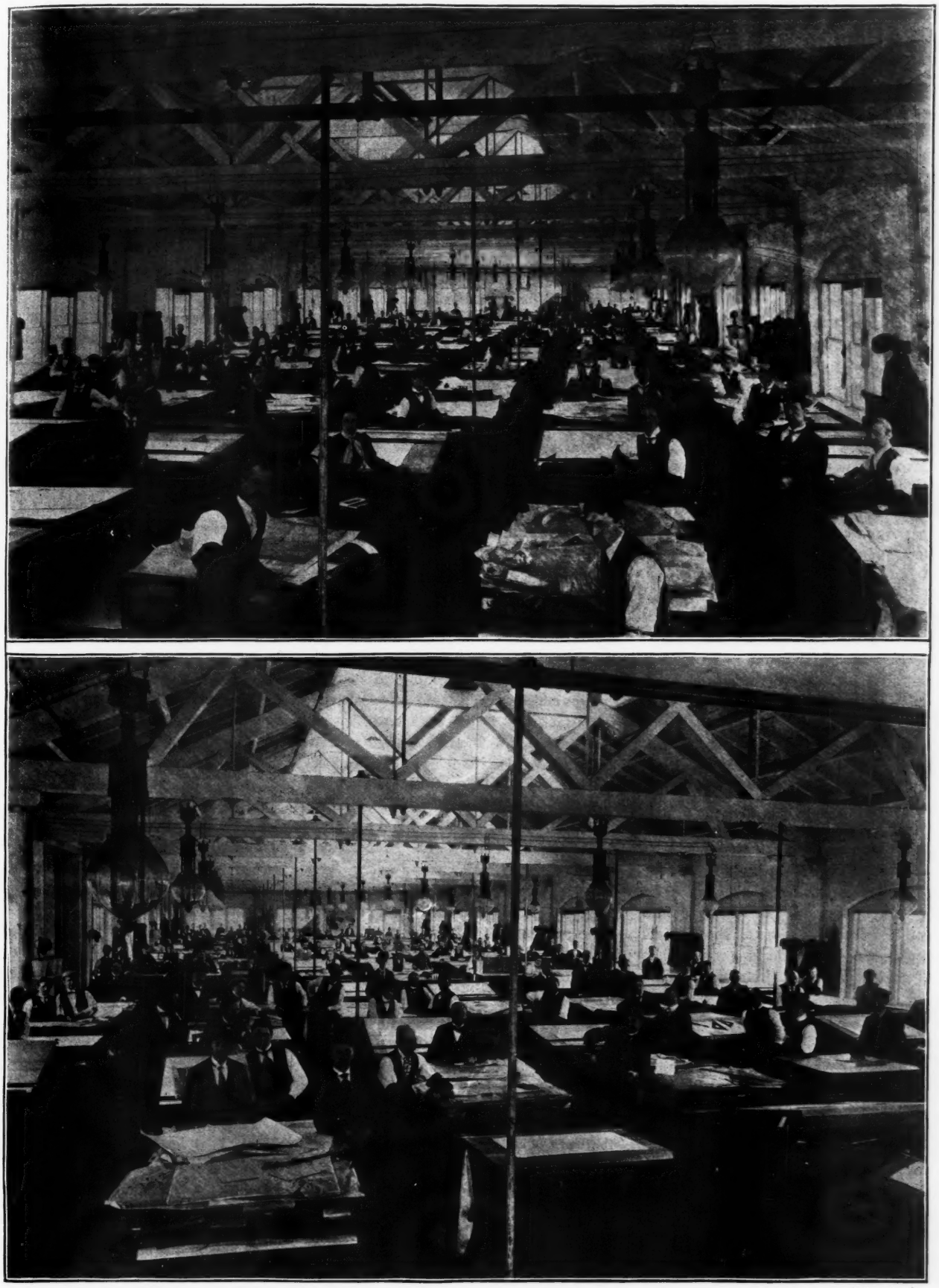
On the curb, or outside market, in New York, Electric Vehicle closed the week at 14 bid and 15 asked, showing a loss of ½ point. Electric Boat closed at 23 bid and 26 asked, indicating a loss of 1 point. Consolidated Equipment closed at 11½ bid and 11¾ asked, showing a loss of ½ point for the week.

Wall street, March 23.



ONE OF THE MEN'S LOCKERS AND WASH-ROOMS AT THE GENERAL ELECTRIC COMPANY'S SCHENECTADY WORKS.

An exchange soon to be installed is that of the Ogle County, Ill., Telephone Company, which will build at Polo.



LOOKING EAST AND WEST FROM NEAR THE CENTRE OF THE DRAUGHTING ROOM AT THE GENERAL ELECTRIC COMPANY'S SCHENECTADY WORKS.

BENJAMIN FRANKLIN'S CONTRIBUTIONS TO ELECTRICAL SCIENCE—I.

BY EDWIN F. NORTHRUP.

The following article is addressed to those who, feeling pride in what America has accomplished in the science and in the application of electricity, may wish to know the extent and the value of the electrical contributions of America's first and, perhaps, greatest discoverer in electricity. Every American schoolboy knows the story of Benjamin Franklin's kite and the invention of the lightning rod. Visitors to the Columbian Exposition will recall with patriotic pride the Latin words over the statue of Franklin at the entrance to the Electricity Building. These words called to the attention of the assembled world the two chiefest accomplishments of our versatile statesman and philosopher: *"Eripuit Caelo Fulmen sceptrus que tyrannis"* (He snatched from the heavens the lightning and the sceptre from tyrants).

But while every one may think Franklin as America's first electrician, the discoverer of the nature of lightning and the inventor of the lightning rod, comparatively few, students even of electricity, are acquainted with the full extent, the ingenuity, and the enduring influence of his electrical experiments and speculations. The inquirer into the historical developments of electricity who reads Franklin's own account of his electrical studies is likely to be surprised to find how much he did and will assign him as high rank among natural philosophers as he holds among statesmen.

We will review in some detail what he contributed to electrical knowledge and thought. Franklin's researches in electricity were begun in Philadelphia in the year 1747. His own accounts of these, together with his electrical theories and speculations, were given in a series of letters written chiefly to a friend in England, Peter Collinson.

A century and a half ago the study of electricity as a science was just beginning. The discoveries of Galvani, Volta, Oersted, Ampere, and Faraday, were as yet undreamed of. Electricity, or the "electric fire" as Franklin often termed it, was then known only as that surprising agent or force which could be called into action by rubbing with fur, cloth, or silk certain substances, termed "electrics," as amber, glass and sulphur. The wonderful bottle of M. Muschenbroek, or the Leyden jar as we now call it, had recently been discovered. There had also been invented crude frictional machines which consisted of a globe or cylinder of glass mounted on an axile to be turned like a grindstone and rubbed by a rubber of silk or cloth. The prime conductor, a large surface of metal for accumulating the charge, had been added to these machines. With such simple contrivances and the bottle of M. Muschenbroek enough electricity was accumulated to give noisy discharges accompanied with flashes of light and bodily sensations never experienced before. The novelty and the wonderful nature of the phenomena of the "electric fire" caused the study of electricity to be of equal interest to men of science, ladies of the court, and to all having leisure and an inquiring mind. In 1747 it was quite the fashion to try experiments with the "electric fire." This was a time when the corpuscular theory of light held, when heat and magnetism were supposed to be fluids, and the "electric fire" likewise could only be conceived of as being some sort of an ether or subtle fluid; an elusive something which abided in certain kinds of matter called the "electrics;" and which friction alone would, in some mysterious manner, excite into activity. Such in brief was the status of electrical science when Franklin first turned his generalizing and ingenious mind to the subject. In those days it was not necessary for a man to be a physicist by training and profession, to think it worth his while to turn his mind to matters "philosophical." The study of electricity was a matter as befitting a man of leisure or a statesman as it was a teacher of natural philosophy. No one was handicapped for the making of discoveries by not knowing what had gone before, for all knew equally little, and all had the same fountain of information to draw from. The curious sought electrical information not in textbooks or treatises, but they turned the parlor or kitchen into a laboratory and put their questions direct to Nature.

How Franklin's attention was drawn to "matters electrical" is told in his first letter on the subject to his friend in England, Collinson, dated March 28, 1747. In this, he writes, "Your kind present of an electric tube, with directions for using it, has put several of us on making electrical experiments in which we have observed some particular phenomena that we look upon to be new. I shall therefore communicate them to you in my next, though possibly they may not be new to you, as among the numbers daily employed in those experiments on your side of the water, it is probable that some one or other has hit upon the same observations. For my own part, I never before was engaged in any study that so totally engrossed my attention and my time as this has lately done, for what with making experiments when I can be alone, and repeating them to my friends and acquaintances, who, from the novelty of the thing, come continually in crowds to see them, I have, during some months past, had little leisure for anything else."

Soon after beginning his experiments Franklin framed his celebrated hypothesis regarding the nature of the "electric fire." The majority of his future investigations were made with the view of testing and demonstrating this hypothesis. The growth in his mind of his theory of electricity gave birth to his most ingenious experiments, and these in turn reacted upon the development of his theory, clarifying and perfecting it.

We will disregard, in the account of those experiments of his which follows, the order in which they were made, and group them as those which bear upon the action of points on the electric charge, those made for studying the action and principles of a charged Leyden jar, his experiments on the nature of lightning, his experiments of a miscellaneous nature, made, many of them, for the entertainment of friends, and those experiments made especially to test his "one-fluid theory." In the limits of this article we can only select those experiments for description which are the more interesting as bearing on some principle, or as showing special ingenuity.

EXPERIMENTS ON THE ACTION OF POINTS ON THE ELECTRIC CHARGE.

Franklin's earliest experiments were made to show the effect of points in "drawing off" and "throwing off" the "electric fire," and it must have been the observations which he made on this matter that first suggested to him his theory of electricity which he later elaborated.

We may here so far outline the nature of this theory (to be more fully discussed later) as to make clearer the language and ideas expressed in the descriptions of his experiments which follow.

In accordance with the ideas in vogue at the time regarding the fluid nature of heat, magnetism and other forces, Franklin conceived all matter and space, near the earth at least, to be filled by an extremely subtle electric fluid. He supposed all matter powerfully to attract this fluid, which he termed the "electric fire," until it had become saturated or filled, the fluid entering the pores of ordinary matter as water enters a sponge. Two portions of the electric fluid, on the other hand, he conceived as mutually repelling each other. When a body is charged positively

it is given a greater share of this "electric fire" than it can naturally absorb, and the surplus hangs about it like a cloud forming an "electric atmosphere." A body charged negatively is supposed to have some of the electric fluid withdrawn from it. The excess fluid on the positively charged body strives to pass into the negatively charged body in virtue of the attraction of this body for the fluid which has been taken from it. He supposes, that when one body has fluid added to it and is positively charged, some other body must have an equal quantity of fluid taken from it and be negatively charged, or the fluid may be drawn from the common stock in the earth.

He describes (July, 1747) his first experiments on the action of points in these words, which we quote in part:

"Place an iron shot of three or four inches diameter on the mouth of a clean, dry glass bottle. By a fine silken thread from the ceiling, right over the mouth of the bottle, suspend a small cork ball about the bigness of a marble, the thread of such a length as that the cork ball may rest against the side of the shot. Electrify the shot, and the ball will be repelled to the distance of four or five inches, more or less, according to the quantity of electricity.

"When in this state, if you present to the shot the point of a long, slender, sharp bodkin, at six or eight inches distance, the repelling is instantly destroyed, and the cork flies to the shot. A blunt body must be brought within an inch and draw a spark to produce the same effect.

"To prove that the electrical fire is *drawn* off by the point, if you take the blade of the bodkin out of the wooden handle and fix it in a stick of sealing wax, and then present it at the distance aforesaid, or if you bring it very near no such effect follows; but sliding one finger along the wax till you touch the blade, and the ball flies to the slit immediately.

"If you present the point in the dark you will see, sometimes about at a foot distance and more, a light gather upon it, like that of a firefly or glowworm; the less sharp the point the nearer you must bring it to observe the light, and at whatever distance you see the light you may draw off the electrical fire and destroy the repellancy.

"If a cork ball so suspended be repelled by the tube, and a point be presented quick to it, though at a considerable distance, it is surprising to see how suddenly it flies back to the tube. Points of wood will do near as well as those of iron, provided the wood is not dry, for perfectly dry wood will no more conduct electricity than sealing wax.

"To show that points will *throw off* as well as *draw off* the electrical fire, lay a long sharp needle upon the shot, and you can not electrize the shot so as to make it repel the cork ball.

"Or fix a needle to the end of a suspended gun-barrel or iron rod, so as to point beyond it like a little bayonet, and while it remains there the gun-barrel or rod can not, by applying the tube to the other end, be electrized so as to give a spark, the fire continually running out silently at the point.

"In the dark you may see it make the

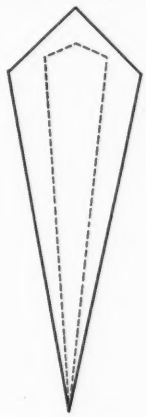


FIG. 1.—THE "GOLDEN FISH."

same appearance as it does in the case before mentioned."

The action of points above described had hitherto escaped the notice of electricians and it is to be considered as a discovery of Franklin's. In the use of the expressions *"drawing off"* and *"throwing off"* Franklin shows that he conceives of the electric fire as something material which may be actually added to a body to give it a positive electric charge.

The most fascinating of Franklin's many experiments on the effect of points on charged bodies is one which he designates the experiment of the "golden fish." In this experiment two circular metal plates are placed in a horizontal position and facing each other, at a foot or so apart. The lower plate is connected to the ground and the upper plate to the prime conductor of his frictional electric machine. Between these two plates a piece of gold leaf having the shape shown in Fig. 1 is made to place itself and move about in the curious manner which Franklin describes as follows:

"Bring this (the gold leaf) on your plate, under the electrified plate, in such a manner as that the right-angled part may be first raised (which is done by covering the acute part with the hollow of your hand) and you will see this leaf take place much nearer to the upper than the under plate; because, without being nearer, it can not receive so fast at its right-angled point as it can discharge at its acute one.

"Turn this leaf with the acute part uppermost, and then it takes place nearest the unelectrified plate; because otherwise it receives faster at its acute point than it can discharge at its right-angled one. Thus the difference of distance is always proportioned to the difference of acuteness. Take care, in cutting your leaf, to leave no little ragged particles on the edges, which sometimes form points where you would not have them. You may make this figure so acute below and blunt above as to need no under plate, it discharging fast enough into the air.

"When it is made narrower, as the figure between the pricked lines, we call it the *golden fish*, from its manner of acting. For if you take it by the tail, and hold it at a foot or greater horizontal distance from the prime conductor, it will, when let go, fly to it with a brisk but wavering motion, like that of an eel through the water; it will then take place under the prime conductor, at perhaps a quarter or half an inch distance, and keep a continual shaking of the tail like a fish, so that it seems animated.

"Turn the tail toward the prime conductor, and then it flies to your finger, and seems to nibble it. And if you hold a plate under it at six or eight inches distance, and cease turning the globe, when the electrical atmosphere of the conductor grows small, it will descend to the plate and swim back again several times, with the same fishlike motion, greatly to the entertainment of spectators. By a little practice in blunting or sharpening the heads or tails of these figures, you may make them take place as desired, nearer or farther from the electrified plate."

Franklin explains the action of the gold leaf as follows:

"When the upper plate is electrified, the leaf is attracted and raised toward it, and would fly to the plate were it not for its own points. The corner that happens to be uppermost when the leaf is rising, being a sharp point, from the extreme thinness of the gold, draws and receives at a distance a sufficient quantity of the electric fluid to give itself an electric atmosphere, by which its progress to the upper plate is stopped, and it begins to be repelled from that plate, and would be driven back to the under plate but that its lowest corner is likewise a point, and throws off or discharges the overplus of the leaf's atmosphere as fast as the upper corner draws it on. Were these two points perfectly equal in acuteness, the leaf would take place exactly in the middle space for its weight is a trifle compared to the power acting on it."

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—V.

BY A. E. DOBBS.

WIRE STRAINS IN SPANS.

The strain upon the span wire, or any other wire for that matter, is something of a mystery to many construction men who generally work by rule of thumb in the matter, relying on their actual experience elsewhere—a guide which is not always reliable.

It is rarely the case, however, that a wire is overstrained to the breaking point—in fact there is a great deal more liability to too much sag in both wires and cables—but it is just as well to have a certain rule of guidance, and the following tables, copied from a handbook issued by the John A. Roebling's Sons Company, may be taken as a safe guide in the matter.

Table No. 1 has been calculated for about one-third the breaking strain of the wire and, while made up for hard-drawn copper (at 60,000 pounds to the square inch), may be applied to iron or ordinary steel wires just as well.

TABLE 1—SPECIFICATIONS FOR STANDARD CONSTRUCTION OF HARD-DRAWN COPPER.

Temperature in Degrees Fahr.	Spans in Feet.					
	75	100	115	130	150	200
	Sag in Inches.					
— 30	1	2	2½	3⅜	4½	8
— 10	1¼	2½	3	3¾	5	9
10	1⅝	2⅝	3½	4⅜	5¾	10¼
30	1¾	3	4	5⅛	6¾	12
60	2¼	4¼	5½	7	9	15⅞
80	3⅛	5⅞	7	8⅝	11¼	18¾
100	4⅛	7	9	11	14	22¼

For spans between 400 and 600 feet the dip shall be 1/40 of the span.

For spans between 600 and 1,000 feet the dip shall be 1/30 of the span.

In the Western country, where the thermometer ranges from 40 degrees below to 120 degrees above zero, the sag is somewhat greater, and in spans of from 130 to 135 feet the rule is 10 inches in Summer and 8 inches in Winter for both iron and copper.

In Fig. 12 is shown a rough and ready method of "sighting wires" which is frequently used by linemen in order to get the proper deflection, from which it will be seen that placing the wire in the groove of the glass and sighting from the lower edge will give a deflection of about two inches; sighting from the top of the arm, about three and one-half, and from the lower side of the arm, about seven and one-half inches.

In pulling up wires, where there are several linemen at work, the man behind should always do the sighting, and he soon becomes quite expert at it. He should be an experienced man, certainly. When, however, two or more wires have been placed, the sighting can best be done by a man on the ground who takes his place about the middle of the section, at an angle of about 45 degrees from the pole line, from which point he can see when the new wire "comes up level with the others" and give the signal to tie in.

From the same authority as that given in connection with table No. 1, is taken a table of the safe-carrying capacity and allowable dip of cable spans at a safety factor of two, which means half the breaking weight of the strands. The table is also calculated for a dip of 0.01 of the length of the span.

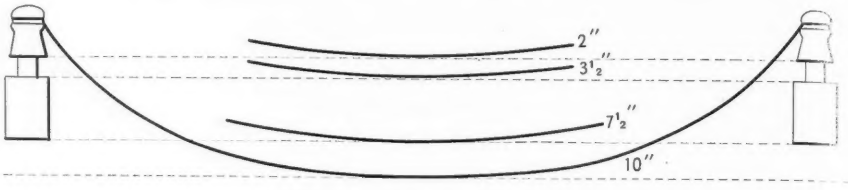


FIG. 12.—DEFLECTION OF SPANS.

TABLE 2—SUPPORTING CAPACITY OF GALVANIZED STEEL STRANDS (ORDINARY).

Diameter in 32ds of an Inch.	Spans in Feet.							
	100	110	120	130	140	150	175	200
	Weights of 1,000 Feet of Cable in Pounds.							
16	2,818	2 516	2.263	2.050	1.867	1.709	1.391	1,154
15	2.520	2 247	2.020	1,827	1.663	1 520	1,234	1,130
14	2,030	1,812	1.640	1,476	1.344	1,230	1.001	900
12	1.580	1.409	1 266	1,146	1,043	953	774	640
10	1,110	900	890	805	733	670	544	450
9	860	765	680	620	563	513	414	340
8	585	521	468	423	3·5	352	285	225
7	433	385	346	313	284	260	210	172
6	337	300	270	245	223	204	165	137

As shown in a previous chapter, the supporting capacity of what is known as "special steel" is more than twice as great as that given above, and this material should always be used with heavy cables, or where especially good work is desired.

It will thus be seen that for lengths up to 130 feet, it will be necessary to use one-half-inch messenger wire if it is desired that the work should look neat and the cable always maintain its position.

There is only one criticism to be made of the above table (Table 2), and that is that it gives the span deflection after the cable is up in place, while construction men are interested in knowing what deflection it should have before the cable is hung on it, for, owing to the stretching and yielding of the twisted strand, a messenger that was originally stretched to a deflection of 0.01 of the span will dip considerably lower when the cable is hung in place. Besides, there will be a certain amount of yielding of the anchors, some stretching of the wire itself, and a certain amount of giving away of the pole line and some slack where the wire is dead-ended, so that the deflections given in Table 3 will be found about right in actual practice. They have been tested, to the writer's knowledge, on several occasions in actual construction and make good-looking work.

The strain was calculated from formulæ given in connection with Tables 1 and 2, and taken at a strain of from 1,900 to 2,000 pounds for one-half-inch strand before the cable is hung on it, and the deflections given can be applied to all sizes of wires, even line wires, it being calculated for one-quarter the breaking strain.

When the cable is in place it will be found that the deflection of 0.01 has been obtained or, perhaps, even more.

TABLE 3.

Feet.	Deflection in Decimal Parts of Span Length.	Deflection in Inches.
30	.001	1/12
60	.002	1.44
90	.003	3.25
120	.004	5.76
150	.005	9
180	.006	13
200	.007	16.8

In pulling up messenger wires three sets of blocks are needed, as shown in Fig. 13. First, the wire should be pulled through in one piece and without splices, if possible, as they will catch and hold the hangers when the cable is being pulled through. When pulled through, one end of the messenger should be permanently fastened with three turns around the pole, if an anchored pole is used, to secure it, and then pulled as tightly as possible with the first set of blocks marked (A). These blocks should be large enough to take a three-quarter-inch rope, which should also be about 200 feet in length. This set of blocks should also be attached to a clamp for holding the wire (C), and when the wire is pulled as tightly as the men at hand can pull it, the end of it should be cut off long enough to reach around the pole three times. Now the second set of blocks (B) can be applied to the rope to

pull the first set, and, later, the third set (C) to pull the second until the required deflection has been obtained.

The future course of action now depends upon the number of messenger wires to be drawn up to that pole, for if there is a second, third or fourth wire to be pulled, the first one should be fastened to the pole with clamps temporarily, and

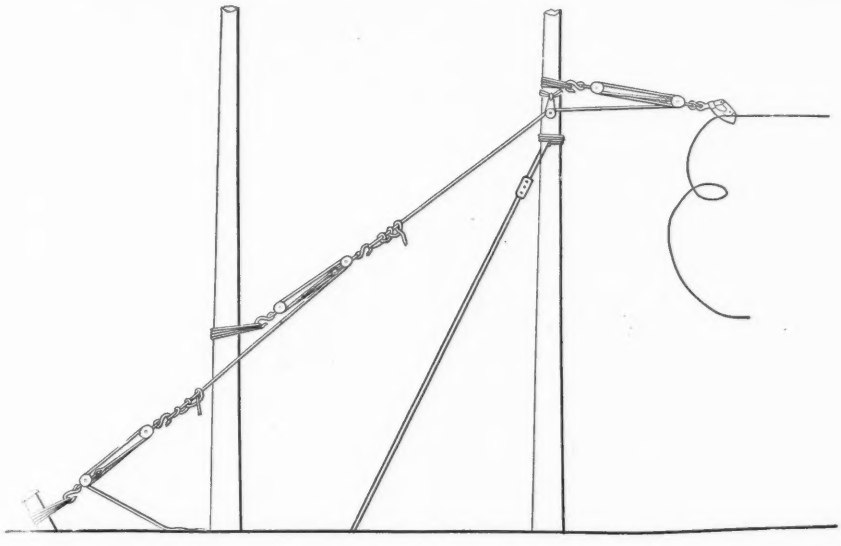


FIG. 13.—METHOD OF PULLING UP MESSENGER WIRE.

the others pulled through in the same manner.

It will now be found that the first wires, owing to a yielding of the pole line and anchors, have become quite slack and need to be pulled again, and they should now be pulled up level with the first, or tight enough to give the required deflection, when they can be fastened permanently by some such devices as are shown in a previous chapter in Figs. 6 and 7.

HANGING THE CABLE.

Not more than 1,000 feet of cable should be pulled through in one length, for even a light 50-pair cable will pull very hard before it gets to where it is going. As the 100-pair cables come on reels that will only contain a little more than 800 feet this precaution is unnecessary for them.

Never pull a cable around a corner if it can be avoided, as it will cost more to do this than it will to make a splice; it can not be pulled with the blocks or capstan, and must therefore be pulled by hand, which it will take the whole gang to accomplish. In making a turn it sometimes becomes necessary to make a turn at a place where a pole can not well be placed, and this is often best accomplished by crossing the messenger wires, as shown in Fig. 14, where the wires cross each other, and, as they are of the same height, they can be tied together for greater security.

A splice can be made near the turn by the men going out to it on the messenger wires and hanging a platform from them on which to work.

When pulling the cable through the hangers can all be put on before the cable leaves the ground and slid up to the messenger on a No. 6 hanger wire.

All hands, and sometimes even the office boys, will be required to pass the cable, for there must be a man on every pole that the cable passes in order to prevent its

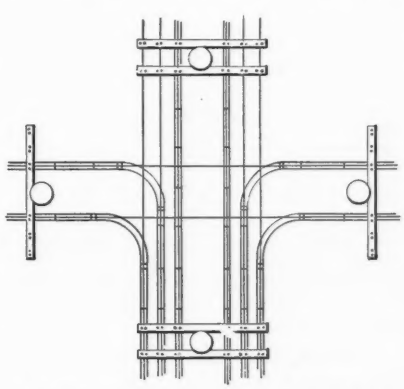


FIG. 14.—CABLE JUNCTION IN MID-AIR AT STREET INTERSECTION.

catching and hanging at the messenger hangers. It might be mentioned that there is now on the market a sort of a bridge, something like a sled runner, that passes the cable by these hangers automatically, but still it will be just as well to have a man on the pole to watch it, anyhow.

It is only necessary to hook up every fifth hanger till the last section is pulling out, when they may all be hooked up.

A New Mexican Electrically Operated Gold Mine.

One of the most unique and curious electric-power transmission systems is to be seen at the Cochiti Gold Mining Company's plant near Bland, New Mexico, where coal is very costly and difficult to obtain. A power plant has been built at a coal mine 32 miles away and the electric current is sent over the line to the gold mine. Even the difficulties in getting water for the generating plant have been overcome by going three miles away from the power plant and making the electricity pump it into the boilers.

The gold mining company had been using wood for fuel at its mine, but it was extremely hard to get as the supply is limited owing to the very rough character of the country. The company then decided to increase the capacity of its cyanide mill, and when an electric plant was designed, a careful examination of the country showed that there was no available water power to be depended upon within 40 or 50 miles. It was then decided to go 32 miles southeast, where there was a coal mine and a town called Madrid. As coal was cheap at that spot, it was decided to build the plant there if water could be had for the boilers. That was the principal difficulty encountered, and it was at last determined to bore into the quicksand of the Galisto River, which is dry on the surface for 11 months in the year. Three or four feet below the surface of the quicksand runs a heavy underflow of water, and a crib was built in the sand, in which a supply of 250,000 gallons is collected every day. In addition to this an artesian well was drilled and the pumps, which are operated by motors, force the water through four-inch pipes to the coal mine. After all this had been done the next obstacle encountered was the feed line from Madrid to Bland. Several arroyos, the Galisto and Rio Grande rivers had to be crossed, both streams being subject to heavy floods each year, and after these had been passed the line had to be run through a narrow, rocky cañon, where holes had to be blasted in rock ledges for poles where there was hardly room for one man to stand. The poles themselves had to be hauled with tackle several hundred feet up the side of the cañon and for long distances material was carried on men's backs. The entire enterprise was, however, successfully carried through and now, with the plant entirely constructed, the total cost for performing 50 per cent more labor is less than one-fourth of the expense for operating the old steam mills, which used wood for fuel.

Annual Meeting of Stockholders of the American Telephone & Telegraph Company.

The annual meeting of the American Telephone and Telegraph Company was held in New York city on Tuesday, March 26, at the office of the company, 15 Dey street. The following report to the stockholders was submitted by the president *pro tem*, and also the financial statement of the treasurer for the year ending December 31, 1900:

To the Stockholders:

It is my painful duty to record the great loss which this company has sustained by the death of Mr. John E. Hudson, October 1, 1900. He had held the office of president of this company since 1887. Immediately upon the organization of the American Bell Telephone Company in 1880, Mr. Hudson became its official attorney. Afterwards he was successively its general manager, vice-president and general manager, and, after 1889, its president. In all these relations he displayed exceptional ability and sound judgment. He gained the respect and confidence of all who were associated with him, as well as of the public, and contributed in large measure to the successful development of the corporation of which he was so long president.

The output of telephones from 1891 to the first of the current year, and the various statistics of the companies operating under our licenses, are exhibited in a consolidated form in the tables which follow:

The tables of mileage herewith include the long-distance toll system owned and operated by this company. This system consisted on the 1st of January, 1901, of 12,427.63 miles of pole line and cable, and 167,410.39 miles of wire, connecting 359 offices; a gain during the year of 420.80 miles of pole line and cable, 17,030 miles of wire, and 36 offices.

The following comparative statement shows the number of exchange stations of the companies with which the long-distance lines directly connect, and which furnish the terminals of that system.

	Number of Stations.	Connected by Metallic Circuit.	
		Stations.	P r Cent.
January 1, 1900.....	557,979	311,129	55.76
January 1, 1901.....	697,674	438,222	62.81
Increase..... ...	139,695	127,093	7.05

The investment in line construction, equipment and supplies for this system, up to December 31, 1900, amounted to $16,152,020.72. The gross revenue from the toll traffic upon these lines shows an increase of 13 45-100 per cent over the amount earned in 1899.

At the close of the year 1899, the property and business of the American Bell Telephone Company, except its holdings in the stock of this company, were taken over by this company.

The revenue statement appended to this report, on the following page, exhibits, therefore, as there stated, the result of operations of the combined properties for the entire year 1900, as compared with the total of revenues and expenses of both companies in 1899.

The exchange of shares under the circular of the American Bell Telephone Company dated April 18, 1900, by the terms of which two shares of the stock of the American Telephone and Telegraph Company were given for each share of the American Bell Telephone Company has been substantially completed.

By a circular dated April 18, 1900, this company offered for subscription by its shareholders one new share for each five shares held by them after the exchange before referred to.

Of the total number of shares so offered (103,545), 103,018 were subscribed for and 51,175 shares were issued on August 1, 1900, and 50,843 shares on January 15, 1901; those remaining (527 shares) were sold by auction and issued in February, 1901.

Collateral Trust Four Per Cent Bonds to the amount of $10,000,000 were sold during the year.

The past year has been one of marked progress in the development of the business, the increase in number of exchange subscribers having exceeded that recorded in any previous year.

During the last three years the number of exchange stations has increased from 384,000 to more than 800,000. This remarkable growth has been due in great measure to the adaptation of improved methods of construction and operation to the needs of subscribers.

The general adoption of the measured service system and metallic circuit party lines, with corresponding lower rates, has attracted many thousands of subscribers, both business and residence, who were previously deterred by the higher cost of other classes of service.

All this has been brought about, moreover, without impairment of the quality of service; as a whole, the standard of construction and efficiency of service has been steadily advanced throughout the country.

In the larger exchanges the old type of multiple switchboards is fast being replaced by relay boards equipped with electric lamp signals and central battery plant, installed in buildings specially designed for the purpose, and owned by the companies.

Material progress has been made also in underground construction, so that at the close of the year, 705,000 miles, or more than half the entire mileage of exchange conductors, were operated under the surface of streets.

Most of the gain of exchange stations consists of those connected by metallic circuits. At the end of 1900, there were 538,000 of that class, making an increase of 154,000 during the year.

It is doubtless true, that, in certain localities, rates too low to cover current expenses and necessary allowance for renewal have been offered, to meet similar rates offered by competitors. We believe, however, such conditions can not be lasting, and the growth throughout the country, as a whole, has been of a healthy and substantial character.

The expenditure to provide for extensions of the business throughout the country has been larger than that of any previous year. The new construction completed in 1900, by this company and the companies operating under our licenses, amounted to $28,862,970.85. Of this sum, $21,914,542.94 was expended upon exchange construction and equipment, and $6,948,427.91 upon toll lines. In addition to the above, $2,349,103.28 was invested in real estate, to be utilized for exchanges and company offices. The entire expenditure for construction, including real estate, to the close of the last year, has been $168,474,517.83.

Estimates already made indicate that the extensions of operating plant during the current year will require further expenditure on a large scale.

INSTRUMENTS IN THE HANDS OF LICENSEES, UNDER RENTAL.

THE FIGURES IN LOWER LINE SHOW INCREASE FROM YEAR TO YEAR.

Dec. 20, 1891.	Dec. 20, 1892.	Dec. 20, 1893.	Dec. 20, 1894.	Dec. 20, 1895.	Dec. 20, 1896.	Dec. 20, 1897.	Dec. 20, 1898.	Dec. 20, 1899.	Dec. 20, 1900.
512,407	552,720	566.491	582,506	674,976	772,627	919.121	1,124,816	1,580,101	1,952,4 2
	40,313	13,771	16,015	92,470	97,651	146,494	205.725	455,255	372,311

EXTRA-TERRITORIAL AND TOLL LINES.

	Jan. 1, 1892.	Jan. 1, 1893.	Jan. 1, 1894.	Jan. 1, 1895.	Jan. 1, 1896.	Jan. 1, 1897.	Jan. 1, 1898.	Jan. 1, 1899.	Jan. 1, 1900.	Jan. 1, 1901.	Increase.
Miles of pole lines.. ...	41,298	42,894	46,727	49,324	52,873	60,453	67,791	75,718	89,292	101,087	11,795
Miles of wire.....	115,088	133,002	154,106	180,557	215,687	268,866	324,883	385,911	501,832	607,599	105,767

TOLL CONNECTIONS.

The average daily number of toll connections is 148,528
Or a total per year of about..... 47,800,000
The toll revenue reported by all companies for the year 1900 was..... $8,972,030.90*

*Not including herein earnings of the American Telephone and Telegraph Company, which will be found in the comparative statement of revenue and expenses appended hereto.

EXCHANGES.

	Jan 1, 1892.	Jan. 1, 1893.	Jan. 1, 1894.	Jan. 1, 1895.	Jan. 1, 1896.	Jan. 1, 1897.	Jan. 1, 1898.	Jan. 1, 1899.	Jan. 1, 1900.	Jan. 1, 1901.	Increase.
Exchanges	788	812	838	867	927	967	1,025	1,126	1,239	1,348	109
Branch offices.....	509	539	571	572	686	832	937	1,008	1.187	1,427	240
Miles of wire on poles.....	180,139	201,259	214,676	232,008	260,324	286,632	327,315	396,503	509,036	627,897	118,861
Miles of wire on buildings.	14,954	14,980	16,492	14,525	12,861	12,594	13,776	15,329	15,087	16,833	1,746
Miles of wire underground.	70,334	90,216	120,675	148,285	184,515	234,801	282,634	358,184	489,250	705,269	216,019
Miles of wire submarine...	1,029	1.336	1,637	1,856	2,028	2,818	2,675	2,973	3,404	4,203	799
Total miles of wire.....	266,456	307,791	353,480	396,674	459,728	536,845	626,400	772,989	1,016,777	1,354,202	337,425
Total circu ts.....	186,462	201,322	205,891	212,074	237,837	264.645	295,904	338,293	422,620	508,262	85,642
Total employés.	8,376	9,970	10,421	11,094	11,930	14,425	16,682	19,668	25,741	32,837	7,096
Total stations.....	216,017	232,140	237,186	243,432	281,695	325,244	384,230	465,180	632,946	800.880	167,934

EXCHANGE CONNECTIONS.

The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is 5,668,986.

Or a total per year of about 1,825,000,000.

The number of daily calls per station varies in different exchanges from 1 to 15 5/16, the average throughout the United States being 7 1/10.

The average cost to the subscriber varies according to the size of the exchange and character of the service, from less than 1 to 9 cents per connection.

The year just passed rounds out the quarter century, within which is compassed the discovery and application of the art of transmitting speech by telephone. A brief review of the development and growth of this new industry, which has become so important a factor in commercial and social life, seems appropriate at this time.

Twenty-five years ago the wonderful invention of Professor Bell was made known to the world. Twenty-three years ago the first telephone exchange in the world was established in the United States, and from that beginning has been built up the great system of exchanges, and the network of connecting lines over which conversation can be held between points over a thousand miles apart.

Twenty years ago there were 47,880 telephone subscribers in the United States, and 29,714 miles of wire in use for telephonic purposes. At the end of last year, there were 800,880 exchange stations equipped with our instruments, and 1,961,801 miles of wire were employed for exchange and toll line service.

The United States has, from the beginning, held the leading place among nations in respect not only of the extensive development of the business, but in the employment of modern and improved appliances, tending to greater efficiency of service.

In connection with the record of development of telephone service in this country, some comparison of the systems of foreign countries is of interest.

The latest reports that can be obtained, part of which are for the year 1899, others to the close of 1900, show the countries next in order to the United States, as respects the development of telephone service, to be the German Empire, having 229,391 stations; Great Britain, 171,660; Sweden, 73,500; France, 59,927; Switzerland, 38,864; Austria, 32,255; Russia, 31,376; Norway, 29,446.

As before stated, there were, at the close of last year, more than 800,000 stations connected with the exchanges of our licensee companies, which exceeds the aggregate number of subscribers in all the countries of Continental Europe.

In addition to this, there were over 40,000 private line stations equipped with our telephones.

The number of exchange and toll line connections in the United States now reaches almost two thousand millions yearly.

The suits of the American Bell Telephone Company *v.* National Telephone Manufacturing Company, *et al.*, and of the American Bell Telephone Company *v.* Central Telephone Company, *et al.*, brought under the Berliner patent in the Circuit Court of the United States for the District of Massachusetts, were argued before Judge Brown in November, 1899. On February 27, 1901, Judge Brown filed a decision for the defendants in each case. An appeal will be taken to the Circuit Court of Appeals.

For the Directors,
ALEXANDER COCHRANE,
President pro tem.

LEDGER BALANCES, DECEMBER 31, 1900.

DEBTORS.

Construction, equipment and Supplies	$16,152,020 72
Telephones	4,311,928 75
Real estate	1,567,018 85
Stocks and bonds	71,719,324 01
Patent account	24,101 00
Machinery and tools	31,477 94
Cash and deposits	1,078,071 70
Bills and accounts receivable	5,240,640 27
American Bell Telephone Co.	22,110,400 00

CREDITORS.

Capital stock	$89,100,500 00
Surplus	1,813,199 74
Bonds	10,006,000 00
Reserves	2,416,363 34
*Bills and accounts payable	2,928,709 91
Contingent	15,970,210 25
	$122,234,983 24 $122,234 983 24

WM. R. DRIVER, Treasurer.

March 26, 1901.

* Of this amount $1,282,277.25 is for the dividends payable January 15, 1901, to stockholders of record December 31, 1900.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

EARNINGS.

	1899.	1900.
Dividends	$3,044,908 89	$3,846,891 67
Rental of instruments	1,714,546 54	2,427,037 52
Telephone traffic	2,668,359 01	3,027,171 85
Real estate	42,285 11	31,824 67
Interest	217,301 53	201,643 50
	$7,687,381 08	$9,534,499 21

EXPENSES.

Expenses of administration	$591,826 34	$746,259 48
Legal expenses	103,748 46	85,134 07
Interest and taxes	1,234,275 83	1,376,199 94
Telephone traffic	1,487,021 88	1,840,847 86
	$3,416,872 51	$4,048,441 35
Net revenue	$4,270,508 57	$5,486,057 86
Net revenue, 1900		$5,486,057 86
Dividends paid		4,078,601 25
		$1,407,456 61
Carried to reserves	$937,258 22	
Carried to surplus	470,198 39	
		$1,407,456 61

N. B.—The foregoing statement for 1899 is for the purpose of comparison and is made up of the transactions of the American Bell Telephone Company and the American Telephone and Telegraph Company in the same form as those which appear above for 1900.

WM. R. DRIVER, Treasurer.

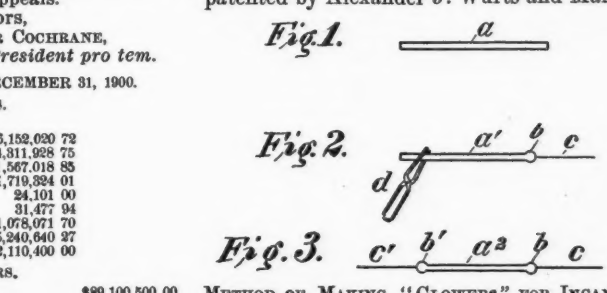
March 26, 1901.

The old board of directors was reelected at the meeting and Messrs. Edward W. Bell and John H. Cahill, secretary of the New York Telephone Company, were added to the board, Mr. Cahill taking the place of Mr. John E. Hudson, deceased. Routine business was transacted and after the usual reading of reports and the secretary's minutes, the meeting was adjourned.

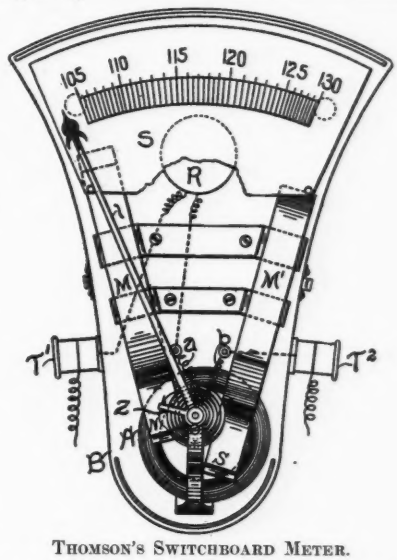
Among those present were Messrs. Geo. V. Leverett, W. R. Driver, E. W. Bell, Henry S. Howe, W. D. Sargent, Charles E. Hubbard, Charles W. Amory, Alexander Cochrane, Thomas Sanders, Hon. John Bigelow, ex-Minister to France, E. J. Hall, Charles F. Cutler and Gen. Thomas Sherwin.

Recent Electrical Patents

Mr. George Westinghouse has obtained control of an improved process for making glowers for electric lamps, recently patented by Alexander J. Wurts and Marshall W. Hanks, of Pittsburgh, Pa. This process relates to that class of glowers which are non-conductive when cold, and conductive when hot. In their manufacture, as heretofore practised, it has been usual to form a rod or string from suitable material while in a plastic condition, then to subject the rod or string to high temperature for the purpose of hardening it, and thereafter to cut it up and give it such treatment as was necessary to put the glowers into condition for service in a lamp. It was found that the heating of glowers by the passage of current therethrough caused the material to shrink to a greater or less extent, and consequently that it was desirable to effect such shrinkage before the glowers were put into final form. The present invention has mainly to do with this shrinking of the glower string or rod and the operations intermediate the shrinking process and the final production of the completed glower.



METHOD OF MAKING "GLOWERS" FOR INCANDESCENT LAMPS.



THOMSON'S SWITCHBOARD METER.

Professor Elihu Thomson has been granted a patent on an exceedingly simple and compact electrical measuring instrument intended especially for use upon switchboards and occupying but little space thereon. A base is provided which carries at its upper end the usual scale. A pair of magnets are secured contiguous to the side edges of the base, and have their poles located at the lower end of and spaced from the face of the same. The shaft carrying the pointer needle is located between the lower ends of the magnets. Secured to this shaft is a thin aluminum disk that is mounted eccentrically and has its edges arranged between the poles of the magnets. This disk carries thin flat coils, which are thus arranged eccentric to the pivot or shaft so that the axes of the magnetic field, developed by current flowing through the coil, will be eccentric to the stationary field of force.

Telephone, Telegraph and Cable Company of America.

The stockholders of the Telephone, Telegraph and Cable Company of America, of New York city, held a special meeting in Jersey City, N. J., on March 26, and approved a resolution of the board to decrease the capital stock from $30,000,000 to $9,000,000 by reducing the par value of the shares from $50 to $15.

Arcs from Electrolytic Oxide Electrodes.

In a recent article appearing in the *Elektrotechnische Zeitschrift*, Mr. Ewald Rasch, of Potsdam, described a new form of arc light which he produced after a long series of experiments. The author points out the fact, which he considers of prime importance, that the temperature of the light-giving surfaces determines the efficiency of any source of light. This, he claims, is the secret of the success of the Nernst lamp, namely, its efficiency of 1.5 watts per candle-power, the temperature being 20.50 degrees centigrade. This, however, he continues, is the highest limit which may be reached, as increasing the temperature any more endangers the life of the filament and the electrode contacts. The new method exploited by the author consists in the formation of an arc between electrodes of magnesia, lime, thoria, zirconia, etc., which arc has physical properties differing widely from an arc formed between carbon electrodes. It is necessary, in order to produce an arc between such electrodes, as is also the case in the Nernst lamp, to first heat the electrodes.

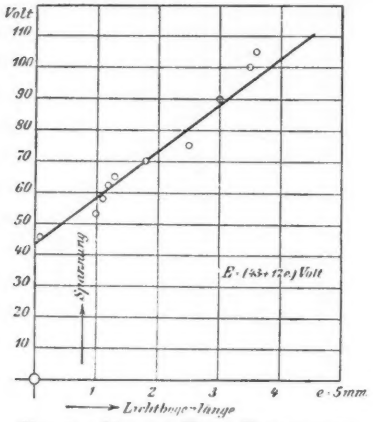


FIG. 1.—MEDIUM HARD ELECTRODES.

This preheating may be accomplished in a very simple manner by means of a small auxiliary carbon arc, while the Nernst method of preheating is by no means a simple one. These supplementary carbon electrodes might be so arranged that without the introduction of any appreciable ohmic resistance the current is transferred from them to the heated ends of the (electrolyte) electrodes.

The energy density at the white hot electrolyte terminals is very large (30 to 40 watts per cubic millimetre or more). The temperature is the highest which can be produced with substances known to man, such as the metallic oxides, borides, silicides and carbides. For this reason the efficiency of the new light must be greater than that of any other method of producing light, and experiments have verified this conclusion.

In addition to this there are few invisible ultra-red lines present in the spectrum of the new light, but a large number of light-giving yellowish-green lines. In fact, the arc between magnesia or zirconia electrodes has the color of sunlight and is far more restful for the eyes than the violet carbon arc to which we have been accustomed.

Not alone, however, are the white hot ends of the electrolytes the light-giving medium, but the white-hot gaseous electrode particles emit considerable light, forming a pure white gas corona having a mellow splendor. This in turn insures a better light distribution and a tempering of the intense glare of the arc.

By properly choosing the substances, a light may be produced whose brilliant coloring will be well adapted for decorative purposes. For example, magnesia,

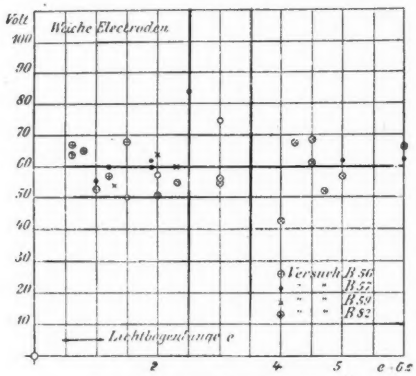


FIG. 2.—SOFT ELECTRODES.

oxide of chromium and nickel give a light distinctly yellow when compared with the ordinary arc light.

A distinction must be made between electrodes having a high resistance when cold and a high conductivity temperature, and those which are fairly good conductors when cold and have a relatively low conductivity temperature. It may be well for the sake of brevity to call the former "hard" and the latter "soft" electrodes. It is possible to make soft electrodes which need no preheating and will emit light when an excessive initial current is employed. It has been found, however, that such electrodes are not as efficient as hard, preheated ones, and the arc between such electrodes will be a very unstable one. The curves shown in Figs. 1 and 2 show the relation between electro-motive force and length of arc for hard and soft electrodes. Soft electrodes form very poor arcs, taking a form resembling ellipsoidal drops, as shown in Fig. 3, and it is with difficulty that an arc is maintained between such points. Frequently a bridge of fluid material b is formed between the points $a\,a$ which extinguishes the arc. The electro-motive-force relations also are very abnormal with soft electrodes. While with carbons the pressure rises proportionally with the length of the arc e, as shown in Fig. 1, this rise in pressure is not noticeable when soft electrodes are used, as is shown in Fig. 2. In fact, the law may be laid down that the efficiency of an arc is greater and the electrodes are more useful and stable the more rapidly the pressure rises with the length of the arc, and that with electrodes which are good conductors and whose coefficient $n = 0$ no stable arc can be maintained.

Using medium hard electrodes, which had to be preheated by means of a match or a Bunsen flame, the author found

$$E = (m + n\,e) \text{ volts.}$$

The constants varied according to the nature of the material; for example, with a current of from 2.1 to 2.6 amperes, between

$$m = 38 \text{ to } 43,$$
$$n = 16 \text{ to } 17 \text{ or more.}$$

As the electro-motive force of the arc (E) is also dependent upon the current strength (J) in such a way that

$$E = k + \frac{b}{J}$$

it was necessary in order to determine the constants b and k to make the length of the arc constant ($e = 1$ millimetre), and to vary the current (J) between wide limits by means of resistances. The results are shown in Fig. 4, and the tangent of the inclination gives the constant K.

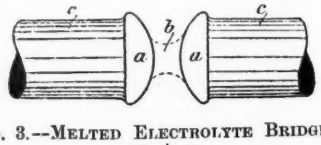


FIG. 3.—MELTED ELECTROLYTE BRIDGING THE ARC.

The ordinate for $J = 0$ is equal to b. The results showed that

$$k = 31.35,$$
$$b = 30.$$

The constant K means the drop of pressure at the electrode terminals. For the continuous-current carbon arc K is about 43 and $b = 32$. For somewhat harder electrolytic electrodes $k = 42$ to 43. Thus it is seen that the electro-motive-force conditions for such electrodes is about the same as those for ordinary carbons.

Experiments were made with electrodes up to 5 millimetres in diameter, and for

laboratory reasons alternating currents were used. It is probable, as is the case with carbon electrodes, that the results would have been more favorable if larger electrodes and direct currents had been employed.

The experiments, however, have shown

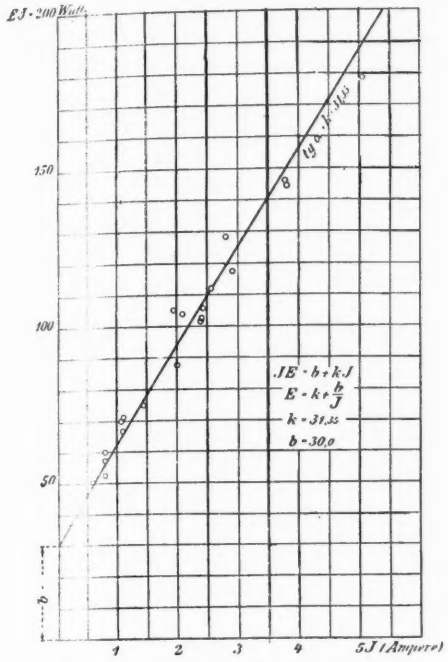


FIG. 4.—ELECTRODES 1 MILLIMETRE APART, 2.5 MILLIMETRES DIAMETER.

that the electrolytic arc is the most efficient artificial source of light.

Several tables are presented by the author, the first showing that with electrodes 2.5 and 5 millimetres in diameter a 600 to 1,000 candle-power light is produced at an efficiency of from three to four candle-power per watt. The current consumption for this size of lamp is therefore from 0.25 to 0.3 watt per candle-power.

Another table shows the relation existing between pressure, current and efficiency, keeping the arc-length (e) constant. Accompanying curves show that the specific light-giving power (with a constant length of arc) rises with the watt consumption. It was found that the candle-power (H) in Hefner candles was

$$H = .028\ (\text{watt})^2.$$

The curve shows a rise up to 5.20 candle-power per watt and then gradually falls, for at that point the electrodes become fluid on account of the intense heat. At this point the pressure was 47 volts, the current four amperes, the watts were 188, and the candle-power was 994. These figures were 65, 1.09, 70.9 and 146.2 when 2.06 candle-power were produced per watt The above corresponds with Tumlirz's figures given in his paper on "The Mechanical Equivalent of Light," namely, that the ideal light production of 100 per cent is obtained when .19223 watt is consumed per candle-power (or 5.21 candle-power per watt).

In fact, as shown in Fig. 1, this ideal condition may be reached with these electrolyte electrodes, although it is only safe to expect about three to four candle-power per watt from the new lamps. Fig. 5 shows the relation between pressure and current referred to above.

While it is true that in practice the arc will not be of constant length, as was the case during these experiments, it has been shown that very economical lamps of even smaller candle-power (100 candle-power) may be produced using electrolytic electrodes.

The curves in Fig. 6 show this new light in comparison with the ordinary arc light, the most efficient light at present.

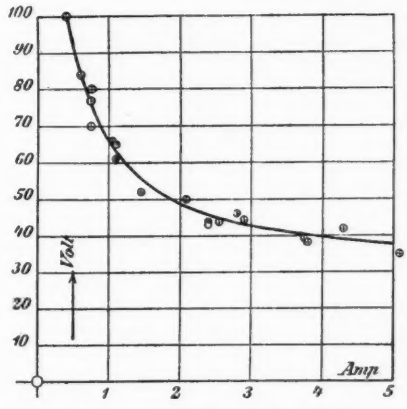


FIG. 5.—ARC LENGTH, 1 MILLIMETRE.

They show that even when alternating currents are employed the new light is more than twice as efficient as the direct-current arc light of to-day, even for small candle-powers.

The following table gives the comparative values of the various methods of producing electric light:

Kind of Light.	Candle-power Per Watt.	Watts Per Candle-power.
Electric incandescent.....	0.29	3.0-4.0
Nernst light.....	0.66	1.5-1.6
Ordinary arc light:		
Alternating current (max.)	1.25	0.8
Direct current (max.).....	2.00	0.5
Electrolytic light	3-4	0.25-0.3

It should be remarked, in conclusion, that it has been shown that the new light is less costly (even if the cost of current is high) than the Welsbach incandescent light. Besides, the new electrodes are perishable only to a very slight extent and only need to be very thin, both factors reducing their cost materially.

Government Ownership of Telegraph Lines in the United States.

At a recent session of the Industrial Commission in Washington, D. C., Vice-president Thomas F. Clark, of the Western Union Telegraph Company, appeared before the Commission to give expert testimony regarding the government control of telegraph lines. The greater part of Mr. Clark's remarks were devoted to considering the wisdom of such a step and he expressed the opinion that those who advocate government control base their advocacy upon the fact that the governments of Switzerland, Belgium and Great Britain control the telegraph lines in those countries. In this country the geographical, sociological and other conditions are so entirely different as to render useless deductions drawn from similar considerations in those countries. Mr. Clark stated that in the United States there are only 67 people for each mile of wire, while in Great Britain there are 130 people to the mile, in Switzerland 220, and in Belgium 321. He also stated that in the United States there are 1,118,086 miles of wire, and in all of Europe 1,585,267. In the United States 29,000 places are reached by telegraph companies while in Great Britain only 10,816 towns

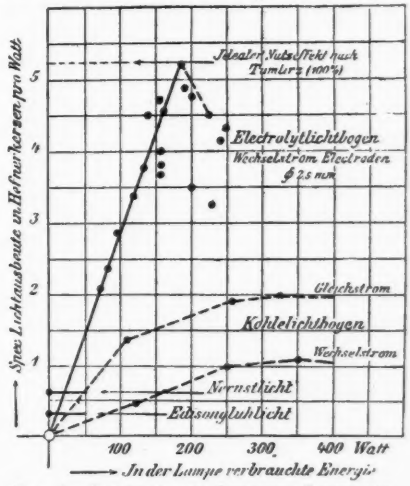


FIG. 6.—DIAGRAM OF SPECIFIC LUMINOUS EFFICIENCIES.

are so connected. Mr. Clark closed his statement with another reference to government ownership by saying that unless there could be a permanent civil service such ownership would result in a serious deficit, and he believed that no good would come from the matter.

Mr. H. B. Scovers, of Carthage, Ill., is reported to have purchased the Henderson County toll line and will continue the head office of the system at Stronghurst. Four of the old directors will remain in the office.

Telephone and Telegraph

Messrs. J. S. Aisthorp and Marion C. Wright are said to have recently purchased the Cairo, Ill., Telephone Company. The consideration is not known.

The A. C. Heimebach Telephone Company, of Burr Oak, Mich., has recently been incorporated for $5,000 and will operate a local system in that town.

A trust deed has recently been filed in Lockport, Ill., by the Northwestern Telephone Company for $5,000, covering its exchanges in Aurora, Joliet and other near-by cities.

The Roach & Seeber Company is reported to have sold its telephone exchange at Waterloo, Wis., to the North & East Bristol Telephone Company. Consideration not stated.

Telephone competition will soon be inaugurated in Jamestown, N. Y., and the Jamestown & Chautauqua Telephone Company has been granted a franchise to do business in that city.

The consolidation of the independent telephone lines of Pennsylvania, Maryland, Virginia and West Virginia, recently noted in the ELECTRICAL REVIEW, will necessitate the forming of a new organization, which will probably be capitalized at $27,000,000.

A local toll service will be installed in the near future in Manitou, Ill., by the Pekin Telephone Company. The last purchase of the Central Union Telephone Company is the Farmers and Merchants' Company, of Quincy, Ill. The line is 75 miles long and runs from Quincy to Pittsfield.

Press despatches from St. Johns, Mich., state that the Union Telephone Company, with lines reaching Saginaw and northwestern Michigan, and the National Telephone Company, of St. Johns, with connections in Lansing, Owosso, Pewamo and Ithaca, have decided to consolidate. The two companies together have about $98,000 in paid-up stock.

A new company will soon be in operation in Rio, Wis., and will be known as the People's Telephone Company. Mr. J. S. Farrington was the previous owner of the local system, and he is reported to have sold his lines, franchises and equipments to the new company. Mr. Farrington was elected president and manager, J. F. Robertson, vice-president, and E. E. Marsh, secretary and treasurer.

At the recent annual meeting of the Saline County Telephone Company, held in Harrisburg, Ill., a 15 per cent dividend was declared and officers were elected for the ensuing year. The officers are Dr. M. D. Mitchell, president; G. H. Mitchell, vice-president; C. F. Parker, secretary and general manager, and T. E. Webber, treasurer. The company owns 60 miles of toll lines in the county and has exchanges in Harrisburg, Eldorado and Galatia.

It is reported that the wire-fence telephone lines, so popular in the United States farming districts, have to a great extent been adopted in Australia by the big ranchers there. In the island-continent the fences are very long and are used by the herders to protect their lands from the encroachments of rabbits. The distance covered by some of these fences is 14 miles. In spite of the fact that the wires are defectively insulated, they are said to perform their functions in an effective and satisfactory manner.

PERSONAL.

Mr. Clinton L. Rossiter, for six years president of the Brooklyn, N. Y., Rapid Transit Company, has resigned and Mr. J. L. Greatsinger has been appointed in his stead. Mr. Greatsinger is an experienced steam railroad man, and is said to have rare ability as an operating manager.

Mr. R. L. Warner has been appointed manager of the Boston office of the Westinghouse Electric and Manufacturing Company. Mr. Warner for some time has been in charge of the engineering and commercial work for the Westinghouse company in southern New England.

Mr. H. Durant Cheever, director of the Okonite Company, Ltd., returned on Wednesday of last week from a four months' sojourn in London. Mr. Cheever went abroad on business for his company and returned well pleased with the results of his trip.

Mr. Waldo H. Curtiss, of Winsted, Ct., has organized the Hartford Motor Machine Company, with a capital stock of $250,000, to build motor street sweepers which will cost from $3,000 to $5,000 apiece.

Mr. Hector Munro Macdonald has been awarded the Adams prize by Cambridge University (England) for an essay on electric waves.

Mr. E. E. Hawkins has been appointed superintendent of the Sea View Electric Railway Company, of Warwick, R. I.

Dividends of Telephone Companies.

There are some 40 or 50 telephone companies operating under a license granted to them by the American Bell Telephone Company, now the American Telephone and Telegraph Company. During the year 1900 dividends were paid by these companies, as follows, on the capital given. It will be observed that eight companies did not pay dividends during that year. One paid 3 per cent; one, 4 per cent; three, 5 per cent; seventeen, 6 per cent; three, 7 per cent; seven, 8 per cent, and one, 12 per cent. The figures we present were compiled by the Boston *News Bureau*, a financial publication of that city:

	Capital.	Rate Div.	Amount Div.
Bell Tel. Co., Buffalo..	$3,000,000	6	$180,000
Bell Tel. Co., Missouri.	2,000,000	8	160,000
Bell Tel. Co., Philadel.	4,000,000	8	320,000
Del.&At. Tel. & Tel. Co.	400,000	8	32,000
Cent. D. & Prt. Tel. Co.	5,000,000	8	400,000
Cen. N. Y. Tel.&Tel. Co.	1,144,400	6	68,664
Cen. Pa. Tel. & Sup. Co.	1,000,000	5	50,000
Central Un. Telephone.	6,600,000	..	.....
Chesa. & Pot. Tel. Co..	4,000,000	4	160,000
Chicago Telephone Co.	7,000,000	12	840,000
City & Sub. Tel. Assoc.	3,465,000	6	207,900
Cleveland Tel. Co.....	3,100,000	8	248,000
Colorado Tel. Co.....	1,800,000	6	108,000
Cumberld. Tel.&Tel. Co.	6,000,000	6	360,000
Duluth Telephone Co..	300,000	..	.....
East Tennessee Tel. Co.	300,000	..	.....
Empire S. Tel.&Tel. Co.	200,000	..	.....
Freeport Tel. Ex. Co...	10,000	..	.....
Hudson River Tel. Co.	3,000,000	6	180,000
Iowa Telephone Co....	931,000	..	.....
The Miami Tel. Co...	40,000	6	2,400
Michigan Tel. Co.....	5,000,000	5	250,000
Missouri & Kas. T. Co.	1,500,000	6	90,000
Nebraska Telephone Co.	1,500,000	6	90,000
N. Eng. Tel. & Tel. Co.	15,000,000	6	900,000
N.Y. & N.J. Tel. Co....	7,665,600	7	536,592
N.Y. & Pa. Tel.&Tel. Co.	1,000,000	6	60,000
N. Y. Telephone Co....	16,000,000	6	960,000
N. W. Tel. Ex. Co....	4,000,000	7	280,000
Pac. St. Tel. & Tel. Co.	3,500,000	6	210,000
Sunset Tel. & Tel. Co..	3,000,000	6	180,000
The Pa. Telephone Co.	600,000	5	30,000
Plymouth & Campton Tel. Ex. Co.....	12,000	3	360
Providence Tel. Co...	1,200,000	8	96,000
Rocky Mt. Bell Tel. Co.	1,200,000	6	72,000
Sthn. Bell Tel.&Tel. Co.	1,000,000	..	.....
The Sthn. Mass. T. Co.	2,500,000	8	200,000
The Sthn. N. E. Tel. Co.	2,511,000	6	150,660
Sthwtn. Tel. & Tel. Co.	7,000,000	6	420,000
Vermt. Tel. & Tel. Co..	40,000	..	.....
Wisconsin Tel. Co.....	3,000,000	7	210,000
	$130,519,000		$8,052,574

Philadelphia Bell Telephone Company.

In order to meet the demands of the rapidly growing system the directors of the Bell company, Philadelphia, have voted to increase their capital stock by $2,000,000. The increase, if ratified by the stockholders at a meeting which will be held at the offices of the company on Tuesday, May 21, will make the capital stock of the company $8,000,000. On March 20, 1900, the capital was increased from $4,000,000 to $6,000,000, this having been brought up from the original incorporation figure of $1,000,000.

Franchises have been granted to the Standard Telephone and Telegraph Company of Pennsylvania, to operate in Langhorne, and work will be commenced immediately on installing a local and long-distance system.

LATE NEWS.

At the annual meeting of the North Jersey Street Railway Company, held Monday of this week, all the old directors were reelected except that J. E. Hulshizer, Jr., succeeded Henry Lembeck, resigned. At the same time the stockholders of the Consolidated Traction Company, now leased to the North Jersey, met and elected all the old directors except that Edward L. Young and Joseph D. Bedle were elected in place of A. Q. Garretson, resigned, and F. A. Matthiessen, deceased. President E. F. C. Young, of both companies, and David Young, general manager of both companies, were reelected at the meeting of the directors, held on Tuesday.

At the regular quarterly meeting of the directors of the Erie Telegraph and Telephone Company, held on Monday of this week, the board authorized the following statement: "The report of the auditors now engaged in examining the accounts has not been received. In its absence the directors are not in possession of information to enable them to take any action upon the question of declaring a dividend."

Hon. George W. Aldridge, formerly superintendent of public works for the state of New York, has accepted the position of general manager of the Citizens' Light and Power Company, of Rochester, N. Y. This company is constructing one of the finest power-houses in the state and is controlled by a number of well-known men identified with electric lighting interests of the country.

The recently incorporated Postal District Messenger Company of New Jersey has been chartered by the Postal Telegraph and Cable Company to include the business of a common carrier and to construct telegraph and telephone lines. The incorporators of the company are W. H. Baker, C. P. Bruch and John O. Stevens, all of the Postal Telegraph and Cable Company.

A house-owner in Paris recently refused to allow one of his tenants to drive an automobile into the central court yard of the building. The tenant then applied to the court and naturally obtained a favorable decision, the court ruling that automobiles must have access to the yard, exactly as other vehicles.

Mr. Frederick J. Allen, of Auburn, N. Y., was appointed by President McKinley United States Commissioner of Patents on March 25, succeeding Mr. Charles Duell, resigned.

Consolidation of the Boston Electric Lighting Companies.

There have been a number of contradictory reports relating to the proposed consolidation between the two electric lighting companies in Boston. The ELECTRICAL REVIEW can announce on information received from an authoritative source that this consolidation has been arranged for, the terms having been agreed to by the individuals composing the boards of both companies. This agreement is, of course, subject to the vote of the stockholders and to the legislature and gas commission, so that at the moment it is more or less misunderstood by the public. The arrangement is that the Edison Electric Illuminating Company is to buy the Boston Electric Light Company by exchanging stock at a certain ratio which is as yet not announced.

A Marine Electric Railway.

A marine electric railway has recently been installed in Liverpool, Nova Scotia, for the purpose of hauling vessels up on a cradle out of the River Mersey to a distance of 500 feet on a grade of one-half inch to the foot. Before this installation it took from four to five hours to haul up a vessel, while on January 11 the first vessel was hauled up in 20 minutes by the electrical apparatus. The equipment consists of a 30-horse-power induction motor, the motor shaft being geared to a heavy worm shaft and wheel gearing into another large wheel, on which shaft is placed a large sprocket wheel. Over this sprocket a heavy two-inch chain meshes into the teeth. It is stated that the installation is the first of its kind in America and probably the first in the world to be electrically operated.

A Motormen's Kindergarten.

The Brooklyn, N. Y., Rapid Transit Company is to put new motormen through a kindergarten instruction in the handling of electric cars. In the school an entire electric car will be maintained in skeleton, with a removable floor, so as to give access to the motors. The new school will be established in the Fifty-eighth street depot, and the superintendent of the road believes that the course of instruction should take from 10 days to two weeks. After the men pass through the instruction department they will be assigned to suburban lines until proficient.

An automobile recently made a trip from New York over the main roads to the exhibition in Philadelphia, Pa., in three hours and fifty minutes.

American Institute of Electrical Engineers.

The 152d regular meeting of the American Institute of Electrical Engineers was held in New York city on the evening of March 22, the paper of the evening being entitled "The Distribution and Conversion of Received Currents," by Mr. Henry G. Stott, of Buffalo. Mr. Stott read his paper at length and it proved to be a deeply interesting communication. It will appear in a future number of the ELECTRICAL REVIEW. The discussion was general and animated. The council nominations for officers for the ensuing year were as follows:

For president, Charles P. Steinmetz; vice-presidents, Samuel Sheldon, Brooklyn; George F. Sever, New York; Michael I. Pupin, New York; managers, Lieutenant-Colonel Samuel Reber, United States Army; Mr. John W. Lieb, Jr., New York; Mr. Charles F. Scott, Pittsburgh, and Professor W. E. Goldsborough, Lafayette, Ind. These announcements were received with applause.

The first *conversazione* of the institute will be held in the Engineering Building of Columbia University, in New York city, on Friday evening, April 12, 1901. Arrangements have been made for the exhibition of many novel inventions by Messrs. C. L. Clark, Clift, Crocker, Cross, Edison, Hammer, Hewett, Marconi, Nichols, Perret, Pupin, Ryan, Steinmetz, Tesla, Elihu Thomson and Townsend, as well as by members of the institute belonging to the engineering staffs of the General Electric and Westinghouse companies. It is understood that Mr. Edison will exhibit at this meeting for the first time his new storage battery, which is said to possess remarkable features. Mr. Tesla will probably exhibit his wireless telegraphy system. The recent improvements in the Nernst lamp worked out by the Westinghouse company's engineers will also be shown.

An invitation card is required and will be sent upon application to members and associates. Each card will admit a member and a lady. Additional invitations may be obtained by members and associates by registering the names of their guests with the secretary and payment of $1. Application should be made to the secretary. The cards will be ready April 1 and should be applied for not later than April 8.

A township light and power plant to be run in connection with the local telephone system is said to be contemplated by the farmers of Belfry, Pa.

Views, News and Interviews

Electric block signals are being installed on the lines of the Jersey Central Railroad between Bound Brook and White Haven.

A special despatch to a New York paper recently stated that a sermon which was delivered over the telephone to the members of the church "held the auditors glued to the receivers because if its force and eloquence, and after the sermon one man telephoned to the clergyman that he had been converted. This was announced from the pulpit."

A curious damage case was recently settled in Tuscaloosa, Ala., for which no precedent in law can be found. A gentleman named Wilson was talking over the telephone during a storm and was struck by lightning, which entered the house over the wires, and killed. Suit was brought for damages and settled by the payment of $1,800 by the telephone company.

The Boston Elevated Railroad Company has 2,100 stockholders, which is 600 more than it had a year ago. Eighty per cent of these are residents of Massachusetts. The balance is scattered over Maine, New Hampshire, New York, New Jersey, Ohio and the provinces. About 850 stockholders are women with comparatively small holdings. There are also about 150 trustees holding stock.

Electricity is to be used on account of its greater safety in the manufacture of cordite in the government factory in the Nilgivi Hills in India and the government is installing a hydraulic electric plant. A near-by waterfall will be utilized and the transmission line will be three miles in length. The installation includes a complete plant of generators, motors, transformers, etc., which will furnish 500 horse-power.

Conductors to be employed by the Brooklyn Rapid Transit Railway Company must hereafter furnish bonds for $500 as a safeguard to that company against dishonesty. It is alleged that the shortage of fares among the 3,345 conductors employed on the various lines amounts to a large sum daily, notwithstanding the company has a corps of keen-eyed spotters constantly watching the indicators on each line. Hereafter the conductors will be watched by an agent of a surety company, as the management believes that this is the only way in which it will be able to save the fares that are supposed to be stolen.

Anent the recent decision of Mr. Justice Russell upon the steam automobile question, a humorous contemporary says that if he were an automobilist himself it would not worry him in the slightest, and, on being asked why, he said: "I would exactly fulfill the judge's requirements and send a man with a red flag half a mile ahead of me."

"But would not that be a good deal of trouble?" asked his friend.

"Not at all," replied the jester. "I would send him in another automobile."

A smart piece of work is credited to the Kidderminster District Electric Lighting and Traction Company, of England, in replacing steam by electric power at short notice. An engine broke down in a Kidderminster factory, owing to the collapse of its main beam, crank shaft and connecting rod. The electric company then came to the rescue, and in less than two days had everything completed for working the mill by electricity. The necessary foundations for the motors had been put in, and a quarter of a mile of cable laid in the time stated. The delay was only 18 working hours to the mill, whereas, in the ordinary routine of such work, the repairs would have taken from four to five weeks.

A Champion of the Electromobile.

[*From the New York Sun.*]

In explanation of the dissolution of the Illinois Electric Vehicle Company, to take place on April 1, a statement has been made which is likely to arouse some curiosity among present and prospective owners of automobiles. It is, briefly, that the poor business done recently by this company in Chicago has, to a great extent, been due to the impossibility of running the electric vehicles in the snow and over icy pavements. A Chicago contemporary says that since the heavy storm of last month "the electric cabs have been practically prohibited from all quarters of the city," except where the streets have been "kept like a parlor floor."

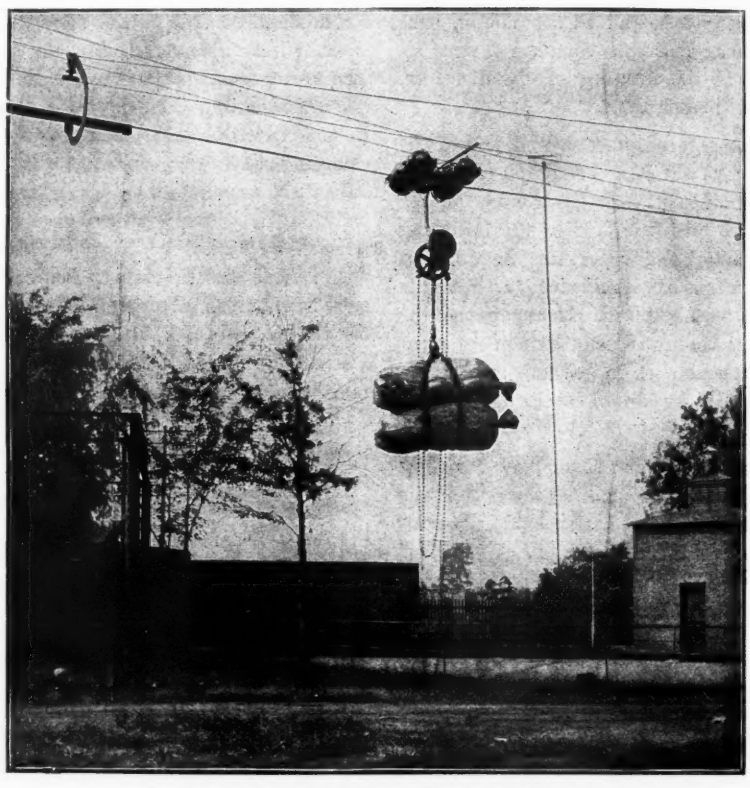


FIG. 1.—BAGS OF CEMENT IN TRANSIT BY TELPHER.

Here in the East it has been demonstrated several times during the last few weeks that snowdrifts, and even snow and ice together, are not equal to the task of stalling "autos," whether the latter be driven by electricity or some other agent. Last month the chauffeurs of Rhode Island proved the power of their machines to travel through snow a foot deep; high and snowy hills were climbed, and ice, wind, snow and grades combined could not prevent the machines' progress. At about the same date as the trial in New England, the Automobile Club of Long Island covered about 35 miles over the icy roads of New York in a cold and stiff wind without a mishap. They were obliged to slacken speed only a few times, and slippery grades were mounted without difficulty.

Some New Telpherage Apparatus.

The system of automatic conveyance of packages and parcels by means of electricity is one of the oldest applications of the electric motor, yet its development has not been rapid and to-day still finds a large field in which it may be employed usefully. Some of the original telpherage systems which were constructed in England are still in operation. In nearly all cases these consisted of overhead cableways on which an automatically driven moving part carried the load which was suspended below it.

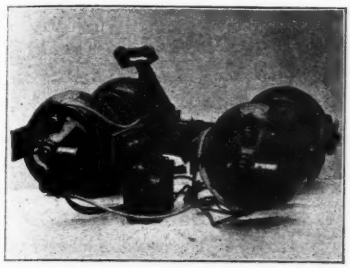


FIG. 2.—DOUBLE UNIT TELPHER.

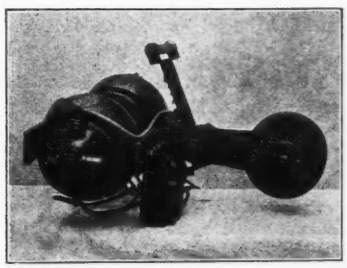


FIG. 3.—SINGLE UNIT TELPHER.

The accompanying illustrations show various parts of the telpherage system manufactured by the United Telpherage Company, of New York city, and lately installed in a number of places. An excellent idea of the method used is obtained from Fig. 1, which shows bags of cement in course of transit. The telpher, or automatic truck which runs along the upper side of the taunt wire cable, consists of four small slow-speed direct-current motors, two directly coupled upon each of the two shafts, upon which also are mounted grooved wheels which run upon the top of the cable. The load is suspended below in the method clearly shown by the illustration. A more detailed view of the telpher may be had in Fig. 2, which represents a four-motor or double unit machine, while Fig. 3 shows one adapted for lighter work and having but a single pair of motors and one idler wheel. From the middle of the apparatus rises a short trolley, making contact by means of a roller so as to allow considerable variation in the position of the trolley wire. The latter is suspended directly above the running cable, one of the illustrations showing the double hanger used, this being also well shown in Fig. 1. The operation of the system is entirely automatic. The current is turned on at one end when it is desired to start the telpher, which accelerates itself gradually up to its full speed—generally about 12 miles an hour—slowing down automatically for curves and automatically switching off the current so as to stop at the desired place at the other end of the line. The Crocker-Wheeler company is using this system at its factory at Ampere, N. J., for handling castings between the factory proper and a foundry.

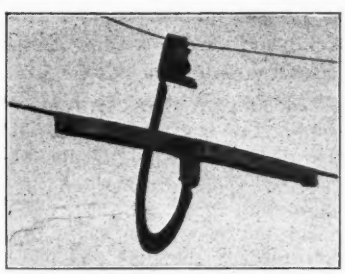


FIG. 4.—DOUBLE TELPHER HANGER.

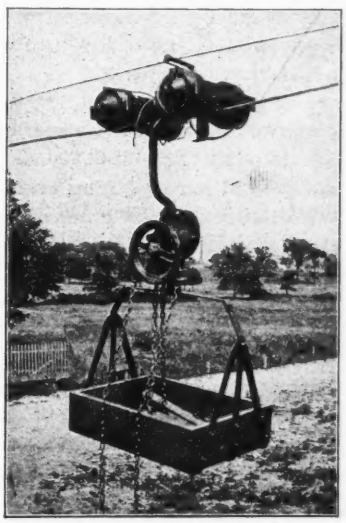


FIG. 5.—SKIP FOR TELPHERAGE.

Telpherage systems are adapted for the handling of a very large number of products, nearly all bulk goods and staple articles which are produced in units weighing less than a ton being conveniently and quickly handled by an aerial cableway. A great advantage of this variety of transporting system over the surface railway of whatever type is its extraordinary flexibility, and the fact that the condition of the surface and such accidents as floods and washouts do not interfere with its operation.

Consolidation of Cincinnati Lighting Interests.

An agreement has been reached after a conference of nearly a week between the Cincinnati, Ohio, Gaslight and Coke Company and the Cincinnati Edison Electric Company for a combination of these two corporations for lighting the city. For the past year or more the two companies have been active rivals, and the combination has now been effected by General Andrew Hickenlooper and N. G. Keenan for the gas company, and C. W. Wetmore, of New York (president of the North American Company), and J. B. Foraker, of the Edison company. The saving which will be made by the combination of these two large corporations will be a fortune itself, and the consolidation means a return to the old 10 per cent dividend of the gas company and possibly an increase over that.

FIG. 6.—BARREL TELPHER.

Another feature of the consolidation is the possible lighting of Kentucky cities from the Cincinnati plants, as the combination of interests will spare the North American Company the trouble of making further investments in Kentucky. The plants in Cincinnati will be able to furnish light to the cities of Covington and Newport, thus accomplishing a saving in operating expenses of $100,000, which is equivalent to a dividend of five per cent on $5,000,000 of capital. The two companies will be under one management, and when the properties of each company are appraised, proportionate joint stock will be issued to the holders in the two corporations.

Contracts for the proposed electric lighting plant at Collegeville, Pa., are said to amount to $12,000.

Electric Lighting

A lighting plant for the county jail at Chattanooga, Tenn., is being considered by the electric lighting committee of the county commissioners, who estimate the cost of the new station at $2,000.

The Bluff City, Neb., Electric Light and Gas Company has recently changed hands, having sold its interests to the Citizens' Gas and Electric Company, of Council Bluffs, for $15,000. The Citizens' company will in all probability greatly increase its capital in the near future and reorganize with new officers.

A franchise was recently granted to a Chicago electrical contractor for the installation of an electric light and waterworks plant in Two Rivers, Wis., at a cost of $60,000. The city contracted for 37 arc lights and 53 hydrants. Work must be finished by September 1 of this year and the plant be in operation by that date.

A New York electric lighting expert named Blossom was recently engaged to inspect the plant of Brockville, Canada, which was purchased a short time ago for $85,000 by the municipality. Mr. Blossom's report was that the plant was not only out of date but also in bad condition. To repair the system as it is now would cost about $63,000, and its actual value is $30,000. Mr. Blossom favored the installation of an entirely new plant at an estimated cost of $125,000.

The contract for lighting the city of Lima, Ohio, for the next 10 years was recently let to the new company (Lima Electric Railway and Light Company) to begin operations February 1. The officers of the company are James B. Mayor, president and general manager; H. S. Denney, vice-president, and H. P. Bissell, secretary and treasurer.

Extensive plans are on foot in New South Wales, Australia, to furnish the city of Sydney with electric power for lighting, transmission and general motive purposes. In order to obtain the necessary force it is proposed to utilize the Blue Mountain rivers, providing for water storage on a large scale. It is believed that during the wet season 40,000,000 gallons can be stored without difficulty, which will be sufficient to run the generating plant at its utmost capacity for 150 days. The total cost of the plan will be under $7,500,000, roughly speaking, and the working expenses have been estimated at $990,000. If the project is successful, the annual income is estimated to be about $3,195,000.

A recent newspaper article stated that the electric light plant which is hidden away in the depths of the Capitol at Washington, D. C., is one which few people ever see or hear of, but which is one of the most complete of its kind in the world. Its function is to supply the Capitol with light and power for elevator service, and its energy is so great that it could light thoroughly the average city of 50,000 inhabitants without taxing its capacity. To duplicate this plant would cost an individual or corporation at the very least $200,000, and Mr. C. P. Gleason, the superintendent of the plant, stated that when worked to its full capacity the plant would run 17,000 incandescent lamps. There are also 150 arc lights distributed about the building and grounds, the power for which is supplied by this plant.

Some Interesting Statistics.

Recent figures regarding electrical enterprises in the United States show that there were in 1898 1,089 street railways in this country, of which 926 were electric, 21 cable, 31 steam, and 111 horse lines. The value of all the roads was $979,500,000 in stock and $530,500,000 in bonds, from which it may be believed that the capitalization of the different companies approximated $1,200,000,000. In telephony 900,000 miles of electric wire were in use in the United States in 1899 with 1,000,000 telephone instruments and 400,000 stations. It is estimated that the capital employed in this industry approximates nearly $100,000,000. Throughout the entire world there are supposed to be 1,500,000 instruments and 1,750,000 miles of wire. In 1876 there were 200 instruments in Europe and 380 in the United States.

In 1898 there were working in the United States 219,893 arc lights and 7,619,000 incandescent lamps. The telegraph field shows a corresponding increase, as in 1858 there were 99,800 miles throughout the world; in 1870, 281,000 miles, and in 1888, 767,800 miles. The total outlay on telegraph and cable lines is understood to have amounted in 1898 to about $497,000,000, and the investments of the world in the various applications of electricity, on December 31, may be estimated at not less than $2,500,000,000.

A Free Industrial Scholarship.

The Manufacturers' Association of New York, at the suggestion of Mr. Ludwig Nissen, its president, has appropriated the sum of $2,000 for an industrial scholarship, including the cost of tuition for four years and incidental expenses. The purpose of the association in providing means for the industrial education of a young man of Greater New York is to encourage young men to qualify themselves for leadership in industrial pursuits by adding to the dignity of labor the advantage of trained hands directed by developed minds.

The Industrial Educational Commission, which does not include members of the association, is as follows: Hon. Alex. E. Orr, chairman; Dr. William L. Felter, secretary; Rev. Dr. S. D. McConnell, Dr. Truman J. Backus and Hon. Henry W. Maxwell.

The boys who may desire to compete for the scholarship are requested to make application in writing, addressed to James T. Hoile, secretary of the Manufacturers' Association of New York, 198 Montague street, Brooklyn. Attention is called to the following restrictions and qualifications: 1. Applicants must be residents of the city of New York. 2. They must be at least 17 years of age. 3. They must have received at least three years' high school instruction or an education equivalent to such instruction. 4. Applicants must have at least two references for scholarship and two for moral character. 5. Each applicant must present a physician's certificate of good health. 6. The successful candidate will be permitted to make his choice of the school or college he desires to attend from the list approved by the commission. 7. The scholarship shall be awarded only to such candidate as is unable to pay his own way through college. 8. No legal responsibility attaches to the successful candidate for the return of the value of the scholarship, but should the financial condition of the student be sufficiently prosperous, he is at liberty to make such returns with the understanding that the money be used for other beneficiaries. 9. Applications should be filed not later than April 20, 1901, and at a later date notices will be issued to competitors, naming the time and place for the holding of examinations.

The taxable property of the Brooklyn Rapid Transit Company has recently been fixed by the Appellate Division of the Supreme Court of the State of New York at $34,997,561, and the tax thereon at $53,449.

Corporation News

INDIANAPOLIS, IND.—Commercial Electric Company. $40,000.

DELTA, OHIO—The Delta Telephone Company has increased its capital stock from $10,000 to $20,000.

BUFFALO, N. Y.—Power Installation Company. $5,000. Directors: G. T. and W. E. Westcott and Max Mauran.

LIVONIA, N. Y.—Livonia Telephone Company. $1,000. Directors: E. A. Bronson, C. E. Hartson and others.

CAMBRIDGE, ILL.—Cambridge Mutual Telephone Company. $2,500. Incorporators: Ernestine and Victor Boltenstein.

DULUTH, MINN. — Coconino Copper Company. $6,000,000. Incorporators: D. Grant, L. P. Doyle and T. F. Noonan, Jr.

CHICAGO, ILL.—Federal Electric Company. $2,500. Incorporators: H. M. Bates, Edward Frey and Evans Holbrook.

EL PASO, TEX.—Southern Electric Company. $10,000. Incorporators: D. L. Berkey, H. L. Lloyd and G. A. Andrews.

CHICAGO, ILL.—Illinois Wire Company. $100,000. Incorporators: G. B. O'Reilly, W. L. Severing and W. S. Carpenter.

BATH, STEUBEN COUNTY, N. Y.—Citizens' Telephone Company. $10,000. Directors: C. B. Stowe, J. H. Fuller and E. G. Hubbell.

ST. PAUL, MINN.—Northville Telephone Company. $15,000. Incorporators: C. E. and P. M. Church and Henry L. Nye.

KANSAS CITY, KAS.—People's Electric Light and Power Company. $2,000. Incorporators: H. C. Ward, C. E. Finlay and C. H. Rickert.

NEW YORK, N. Y.—Electro-Mechanical Company. $25,000. Incorporators: A. Prochowrick, J. Pronick, G. H. Englehard and N. Bijur.

ROCHESTER, N. Y.—Crescent Electrical Manufacturing Company. $2,000. Directors: C. R. Elliott, A. L. W. Miller and H. W. Russell.

ROCHESTER, N. Y.—J. B. Snyder Supply and Electric Company. $25,000. Directors: C. E. Snyder, W. C. Burnette and W. L. Peacock.

HOPEWELL, N. J.—Hopewell Electric Light, Heat and Power Company. $100,000. Incorporators: C. P. Fitch, S. H. Blackwell and J. B. Hill.

SYRACUSE, N. Y.—Automatic Trolley Catcher and Controller Company. $100,000. Directors: H. D. Milloy, J. H. Devire and W. S. Farmer.

FOSTORIA, OHIO—Ohio Northwestern Railway Company. $2,000. Incorporators: W. J. Clark, John A. and H. E. Bradner and others.

TOWSON, MD. — Suburban Telephone Company of Baltimore County. $10,000. Directors: J. A. Sheridan, Richard Vincent, C. R. Mace and others.

BAITING HOLLOW, L. I.—Baiting Hollow & Roanoke Telephone Company. $500. Directors: M. V. and C. V. Young, C. Werner and G. F. Terry.

AUGUSTA, ME.—Harpswell & Brunswick Electric Railroad Company. $100,000. Incorporators: J. O. Bradburg, C. B. Harrison and H. L. Pettingill.

COLUMBUS, OHIO—Columbus Grove & Southwestern Railway Company. $25,000. Incorporators: A. G. Grant, H. A. Fischer, G. B. Durnell and others.

ELIZABETH, N. J.—Union Township Electric Company. $2,000. Incorporators: John, Hamilton F. and J. H. Kean, J. W. Whalen and Frank Bergen.

TRENTON, N. J.—United Telpherage Company; $1,500,000; incorporators: C. M. Clark, Henry McL. Harding, W. T. Wallace and H. H. Tyndale. Southern Telegraph Company; $100,000; incorporators: S. Duncan, J. T. Landis and G. H. B. Martin.

SEDALIA, MO.—The Sedalia Electric Light and Railway Company was recently sold at commissioner's sale to W. B. Broomall, of Philadelphia, Pa., for $10,000. Mr. Broomall represented the first mortgage bondholders and the road is now subject to $250,000 indebtedness.

EAST ST. LOUIS, ILL.—Winstanley Electric Light, Power and Gas Company; $2,500; incorporators: W. W. Dean, H. P. Taussig and M. C. Gautier. Winstanley Park Railroad Company; $10,000; incorporators and directors: D. P. Alexander, J. Voitleine, C. White, E. O'Connell and B. B. Smith.

COLUMBUS, OHIO—Girard & Lowellville Belt Line Railroad Company and the Girard, Thornhill & Haselton Railroad Company. Incorporators: C. W. French, T. W. Sanderson, L. E. Cochran and others. The two companies will be consolidated under the name of the Youngstown Belt Line and Terminal Railroad Company. Capital not stated.

Account of Fire Exaggerated.

The National Carbon Company, Cleveland, Ohio, had a small fire on March 18, the extent of which was greatly exaggerated by the daily papers, the statement being made that the works were totally destroyed, when, as a matter of fact, only the laboratory was damaged. The company says that the fire will not in any way interfere with its filling orders, the factory not having been shut down for even an hour.

President McKinley to Open Pan-American Exposition from His Private Car.

Plans have been decided upon for the opening of the Pan-American Exposition in Buffalo, N. Y., on May 1, at which time President McKinley and his cabinet are expected to be on their way to the Pacific coast. The President's train will be connected by telegraph with the Temple of Music and direct telegraphic communication will also be established with the executive offices of the presidents of all the republics in the western hemisphere and the Governor-General of Canada. At exactly two o'clock, Buffalo time, all these gentlemen will touch electric buttons which will each start a piece of machinery of the Exposition, at the same time sending a message of greeting. Then President McKinley from his special car will start the great fountain pumps, sending his message of congratulation to the people assembled on the occasion of the opening. The details connected with this novel and remarkable arrangement are now being worked out and it is believed will prove entirely satisfactory.

The Metric System in the British Empire.

At the congress of Chambers of Commerce of the British Empire, held in London in June last, the following resolution was passed: "That this congress is of opinion that the metric system of weights and measures should, as recommended by a select committee of Parliament in 1895, be legalized in all parts of the Empire (excepting India) for all purposes, and after a period of two years be everywhere rendered compulsory by act or ordinance, and that meanwhile the system should be thoroughly taught in all public elementary schools as a necessary branch of arithmetic, and that copies of this resolution be sent to Her Majesty's Government, and Her representatives in the colonies with the request that they will give immediate and full effect to the proposals contained therein."

Automobiles in The Sahara Desert.

The great Desert of The Sahara, in Africa, is the last place to be invaded by the automobile and two machines, belonging respectively to two Belgian barons, MM. Joseph Pierre and de Crawhez, are said to have made a great sensation near Laghouat. The natives who were passed by the machines on the route are said to have appeared surprised and frightened, and ran, shouting, away. "They are the devil's machines," said the natives.

Electric Railways

Press despatches from Houston, Tex., state that the Beaver Valley Traction Company will soon put new cars on its lines.

A company known as the Kettle River Power Company, of England, has recently been incorporated with a capital of $1,000,000 to acquire the rights of the Cascade Water, Light and Power Company, Limited, and perform similar work.

Mr. W. C. Coffin, the New York electric railroad expert who was recently retained by the officers of the company which will build a line between Canisteo and Jasper, N. Y., states that it will cost approximately $12,000 a mile to build the road.

A large electric power plant is soon to be established on the slope of Mt. Hamilton, about 20 miles from San Jose, Cal. A reservoir three miles long and half a mile wide is to be constructed to receive the waters of Santa Ysabel Creek, and the plant when completed will develop 5,000 horse-power.

Mr. David Wilson, of Tacoma, Wash., is reported recently to have organized a company to develop and utilize the water power of the Spokane River Falls. The company will expend about $200,000 during the year in building a power plant which will furnish energy for use through the Big Bend country for a radius of 50 miles.

At the recent meeting of the Ottawa, Canada, Electric Railway Company officers were elected for the ensuing year, and the reports presented showed that the company carried 7,940,656 passengers during 1900, an increase of 2,000,000 over 1899. This company is introducing an electric sweeper built on a new principle, having double the power of other sweepers, having two 50-horse-power motors.

A bill was recently presented to the Connecticut General Assembly to compel every electric railroad in the state to supply a map of its lines. The author of the bill, Professor W. H. Brewer, of the Yale Scientific School, stated that his object in introducing the measure was to ascertain whether responsible parties were in charge of the lines and to determine whether charters had been gotten for the purpose of preventing some one else from building.

A company of Kansas capitalists has been formed in Independence, Kas., to put in an electric railroad line connecting the three natural gas towns of Montgomery County. The route for the line has been laid out and preliminary surveys completed. The system is intended to handle freight as well as passengers, and as Cherryvale, Coffeyville and Independence have up to this time grown so rapidly it is believed that the road will be a paying investment. Mr. I. B. Wallace is one of the backers of the system.

Surveys have recently been made along the Cranbury turnpike from New Brunswick, N. J., to Cranbury, and it is reported

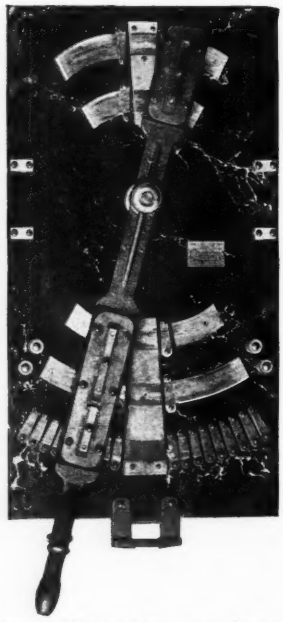


FIG. 2.—HAND-OPERATED REVERSIBLE RHEOSTAT CONTROLLER.

that the Somerset & Middlesex Traction Company intends to extend its New Brunswick & Milltown lines in the direction of Cranbury. The merchants of New Brunswick are eager for the construction of such a line, as they believe it will bring to town a great deal of the country trade which it is now difficult to obtain.

If the franchise of the Chicago, Ill., City Railway Company is extended for a period on terms satisfactory to both the company and the municipality the traction company will expend $9,000,000 for the construction of a new plant and the purchase of an entire new equipment. While the company desires to operate its lines by the overhead trolley system, President D. G. Hamilton says he is willing to operate the cars in the downtown districts by means of the underground system.

Capitalists in the East are said to be figuring on the investment of $5,000,000 in some of the public utilities of San Jose, Cal., and the near-by towns, the purpose involving the extension of electric railroads on both sides of the bay from San Jose to Alameda, Oakland and San Francisco. Mr. J. H. Henry, president of the San Jose & Santa Clara Street Car Company, said that a plan had been under way for some time for combining the Oakland, Hayward, Peresidio, San Jose and Santa Clara roads under one management, besides the electric lighting of San Jose and other neighboring cities. The capitalists who succeeded in bringing about the consolidation of the St. Louis, Mo., lines are said to be behind the present

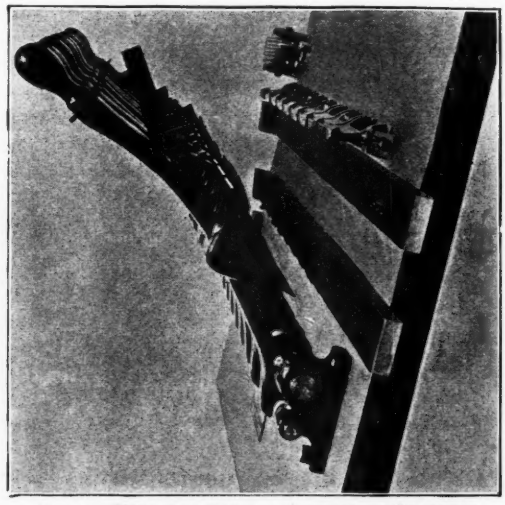


FIG. 1.—MULTIPLE SWITCH AUTOMATIC STARTING RHEOSTAT WITH INTERLOCKING SWITCHES.

movement and are reported to be from Boston and New York. Their identity was, however, not made public.

Messrs. A. L. Johnson, of New York, and R. E. Wright, of Allentown, Pa., are said to be at the head of a number of capitalists and promoters who intend to establish direct trolley connection between Philadelphia and New York, and to give Philadelphia three-cent flat fares. If the plan is successful the new line will be brought directly down Broad street in Philadelphia, and a local service with three-cent fares and a universal transfer system will be established in that city. The New York line will be run at a guaranteed speed of 50 miles an hour, the fare between Philadelphia and New York being 50 cents. The syndicate which Messrs. Johnson and Wright represent is the one which now owns the Lehigh Valley Traction Company, which operates 175 miles of road in the Slatington coal district, and has a clear right of way already from Trenton to the Philadelphia city line, most of the road between those two cities being finished. Further mention of the company's plans will be made in a later number of the ELECTRICAL REVIEW.

National Electric Trades Association Meeting.

The regular annual meeting of the National Electric Trades Association was held on March 24, in Chicago, Ill, at the Grand Pacific Hotel, and delegations from New York, Philadelphia, Boston and Baltimore were handsomely entertained by the local association with a dinner at the Union League Club and a theatre party afterwards. A most enjoyable meeting was held, and officers were elected for the ensuing year: President, Mr. W. M. Carpenter; vice-president, Mr. C. B. Price; general secretary and treasurer, Mr. Frederick P. Vose; board of managers, Messrs. W. M. Carpenter, of the Western Electric Company, Chicago, chairman; C. M. Wilkins, of Partrick, Carter & Wilkins, Philadelphia; F. D. Lawrence, of the Standard Electric Company, Cincinnati; C. B. Price, of Pettingill-Andrews & Company, Boston, and R. E. Gallagher, of the New York Insulated Wire Company. The next meeting of the association will be held in March, 1902, at Philadelphia. The session just held in Chicago is said to have been one of the most enjoyable meetings ever held by the association, and the genial liberality of the Chicagoans was highly appreciated by the visitors.

LEGAL NOTE.

An injunction has been issued by Judge E. H. Lacombe, of the United States Circuit Court for the Southern District of New York, against the Lorain Steel Company, on the suit brought by the General Electric Company, alleging infringement of Anderson's patent of October 1, 1889, on spring contacts for improving the conducting qualities of trolleys.

Some Novel and Interesting Rheostat Apparatus.

Hardly any appurtenance of the electrician has been developed more rapidly and thoroughly than the rheostat. In the early days the resistance box was always a clumsy contrivance—also very liable to be a dangerous one—but the modern rheostat is of extraordinary compactness and efficiency and fully meets with the requirements for safety imposed by boards of fire underwriters upon such apparatus. The accompanying illustrations show some recent apparatus of this kind constructed by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis.

In Fig. 1 is shown a multiple-switch automatic starting rheostat, with interlocking switches. This method of making a motor-starting rheostat is entirely different from that ordinarily practised and used for small motors, since the sliding contacts are entirely superseded and a system of switches substituted for them. In building starting boxes, having a sliding contact working over a divided arc, it has been necessary to divide the resistance into a very large number of parts so as to cut down the sparking when the contact is moved from one to the other. With the system here illustrated it is claimed that there is no sparking whatever at the switch in starting a motor, whether or not its load be connected, and that it is not necessary to divide the rheostat into so many sections. The switches make contact by means of a large number of thin leaves of brush copper which press against a hard-rolled copper surface with just sufficient scraping motion to keep all the surfaces clean and bright. Switches built on this principle, it is stated, will carry 250 amperes per square inch of contact surface without heating, whereas the ordinary commercial knife-switch is rated by the underwriters at only 50 amperes per square inch.

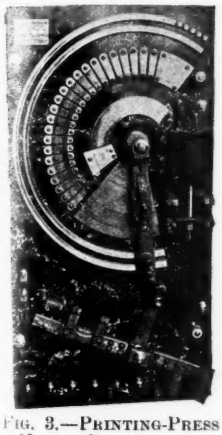


FIG. 3.—PRINTING-PRESS MOTOR CONTROLLER.

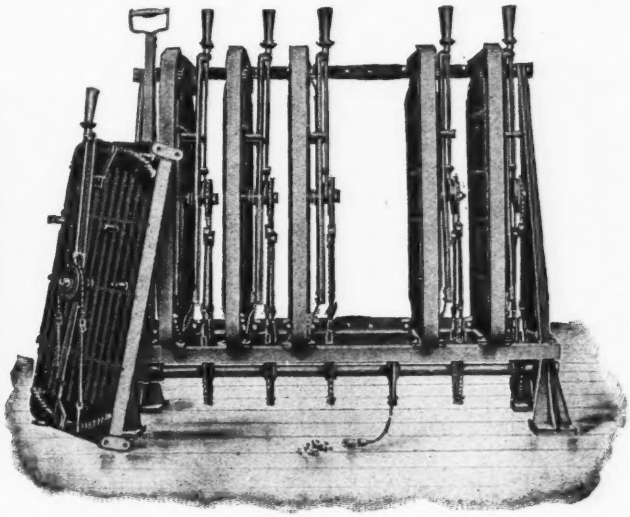


FIG. 4.—THEATRE DIMMER.

Referring to the illustration, the first switch on the left-hand side is held closed by an electromagnet, and all the other switches are held closed by latches. In front of each switch is a pivoted cast-iron stop so arranged that no switch can be closed until the one next to it on the left has previously been closed. These stops therefore constitute the interlocking mechanism. When the current is shut off the first switch on the left opens and allows the stop on switch No. 2 to drop so that this also opens, releasing the catch on No. 3, and so on until all the switches open automatically.

Fig. 2 shows a hand-operated reversible controller rheostat of a type designed especially for connection with electric crane and hoist motors or elsewhere where a reversible motor is necessary. The illustration so well shows the construction of this controller that a description seems unnecessary.

The control of printing-press motors, especially those direct-coupled to large presses, has been an exceedingly interesting and complex problem to the electrical engineer. In Fig. 3 is shown a controller for this class of work which has been evolved as the result of considerable experience in constructing this class of apparatus. In setting up the plates on the rollers of a large newspaper press, for example, it is necessary to be able to turn the cylinders slowly but positively over a very small portion of one revolution. The press must be stopped and started often and driven along inch by inch during the "make-ready" process. The second operation, which is threading in the paper, requires a slow, steady speed and very accurate control. The controller here illustrated combines in itself means for control to produce all these desired speeds.

In Fig. 4 is shown an interesting apparatus used in theatres for the control of groups of lights and known technically as a "dimmer." The conducting material in the flat rheostat is imbedded in an insulating compound and completely enclosed in a metallic casing. The facility with which these instruments lend themselves to grouping together in banks is readily seen in the illustration, which shows several of them so mounted together. The steps are graduated so that there is no perceptible jump of the light in passing from one to its neighbor, and perfect control is given between full candle-power and the "red-hot hairpin" stage.

Industrial Notes

EMERSON ELECTRIC MANUFACTURING COMPANY is sending out its daily reminder desk calendars for 1901, and will be pleased to mail a copy on application to any electrical man.

THE MORRIS ELECTRIC COMPANY, 15 Cortlandt street, New York, is issuing its "Advertiser" and the current issue contains Professor Elihu Thomson's *Sun* article on "Progress in Electricity in the Past Century."

THE DE DION-BOUTON MOTORETTE COMPANY, Brooklyn, N. Y., has made a considerable reduction in the prices of its smaller sizes of imported gasoline motors, used particularly for bicycles, tricycles and small automobiles.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., states that it is making large shipments of Packard transformers. The company has the western agency for these transformers and states that business is very active in that line.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued Bulletin No. 2 on small Kellogg switchboards. The book contains much matter of interest and will be mailed upon application to any telephone man interested.

BROWN & McLAIN, 41 Federal street, Boston, Mass., are selling agents for the Mitchell Gas Generator and Burner Company, and are sending out literature relative to that company's product. The agents are a new firm and have only recently started in business.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., has recently sent out, with its compliments, a vulcanized rubber watch charm in the shape of a telephone receiver, stamped in silver with the company's name upon the mouth-piece, and mounted in gold.

THE AMERICAN ELECTRIC FUSE COMPANY, New York and Chicago, is making a specialty of switchboard lamps for telephone service. This company has recently issued a new catalogue apropos of fuses, fuse wire, fuse blocks, fuse links, McIntire and American connectors, distributing boards and magnet wire.

THE SPRAGUE ELECTRIC COMPANY, New York city, has issued its catalogue No. 303 of Lundell fan motors for the coming season. The catalogue embodies the principal features of the fans, contains matter of considerable interest and will be mailed upon application. The frontispiece shows a Lundell fan in operation in the far north.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD has contracted with the American Bridge Company for two draw bridges, which are to be operated by gasolene engines; one of them to be located near New Hamburg, N. Y., and the other one near Little Ferry, N. J. Both are through plate girder bridges with double track.

THE COLONIAL ELECTRIC COMPANY, Ravenna, Ohio, manufacturer of incandescent lamps, is advertising and quoting prices on a unique system for buyers of incandescent lamps known as the "future delivery contract," which, it is claimed, enables the consumer to buy lamps very low, and to receive these lamps under a complete guarantee.

THE AMERICAN TOLL TELEPHONE COMPANY, Cleveland, Ohio, has made some most interesting accomplishments in the development of automatic toll telephone boxes for pay stations. This company has recently issued a catalogue showing the general principles of construction, and types of toll boxes, which will be of interest to telephone exchanges.

THE HUNTER FAN AND MOTOR COMPANY, Fulton, N. Y., is ready for immediate shipments of the newest types of the Tuerk alternating-current ceiling fans. This company is represented by E. B. Latham & Company, 136 Liberty street, New York, as general agent and for export patronage. Its western agent is the Western Electric Company, Chicago, Ill.

THE AMERICAN BRIDGE COMPANY has secured the contract for the bridge over the South Shrewsbury River at Seabright, N. J. This contract includes furnishing cylinder piers and abutments, four deck-plate girder spans, and one draw span 220 feet long. The bridge will have a 30-foot roadway, and two seven-foot sidewalks. The contract is with Monmouth County, N. J.

THE SEABOARD AIR LINE RAILWAY COMPANY, Portsmouth, Va., is mailing its calendars for 1901 and will be pleased to send them postpaid with its compliments to any one who desires them. The board portion of the calendar is decorated with roses and a half-tone likeness of a little girl looking at the route of the railway, while from the bottom of the card depend the twelve sheets containing the calendar proper.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., manufacturer of the chloride accumulator, announces that a sales office has been established at Cleveland, Ohio, and Mr. E. V. Stebbins, formerly of the Philadelphia staff, has been placed in charge as manager. The office will be located in the New England Building, and all business from this territory will be handled by Mr. Stebbins with promptness.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., are mailing their general circulars and with them are sending testimonials from students who have completed their courses and improved their positions accordingly. Some of the testimonials are of unusual interest and seem to indicate that the courses furnished by the schools are all that they are claimed, being a highly reliable and trustworthy institution.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has the sales agency for a new incandescent lamp called the "Hylo" paper filament lamp, having two distinct filaments, one giving one and the other 16 candle-power. Changing the light from high to low power is done by slightly turning the lamp in the socket. This is said not to introduce a resistance as in other regulating lamps as the changing mechanism is a part of the lamp not requiring a special socket. The lamps are made in Edison, T-H, and S-M bases from 50 to 125 volts.

THE SIEGRIST LUBRICATOR COMPANY, St. Louis, Mo., announces that on account of its increasing business the property at the northwestern corner of Second and Vine streets has been purchased and on this a four-story brick structure will be erected. The company also announces that the Anheuser-Busch Brewing Association has specified the Siegrist system of automatic lubrication for its new lighting plant, and the Memphis, Tenn., Light and Power Company also ordered the Siegrist lubricators for its entire station.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is pushing the sale of its flake graphite which is of particular value to users of machines. The Dixon company states that its graphite has been used with marked results in freedom from friction and in better appearance of type work upon linotype machines, and western users are said to have stated that it prevents "whiskers" on the type. Samples will be sent to any one interested in the matter.

THE LINCOLN ELECTRIC COMPANY, 73 Ontario street, Cleveland, Ohio, is making a line of bipolar, multipolar and alternating-current dynamos and motors; also motors for elevators, plating dynamos and rotary transformers. These machines are fully and well illustrated in a recently issued catalogue. During the past year the Lincoln machines have received many and strong endorsements from discriminating engineers.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 99 Orange street, Newark, N. J., has issued its bulletins No. 13-A, 15-A, and 114-C, dealing respectively with the Manhattan multiple alternating enclosed arc lamp, Manhattan multiple direct-current and the Manhattan series alternating enclosed arc systems in connection with the Manhattan regulator. These bulletins contain full descriptive matter of the company's product, illustrated with numerous half-tone engravings and will be mailed upon application to any one interested.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, will soon issue its new opera "To Win Thee Favor" and by way of introduction makes a "44 calibre" offer with special reference to introducing its bridging exchange telephone instruments. The company also advertises its Peerless trio and gives as the cast of the opera: Mr. "F." Desk-Set; Mlle. Type "E"; Mr. Twin Set, and as heavy villain "His Majesty The Telephone Imp, now at large." These mummers will be "supported by a full chorus with no vital parts exposed." The company will be pleased to mail all its descriptive matter to any one interested.

THE MOLONEY TRANSFORMERS have proven in practice that the careful design they embody has been consistently worked out and carried into effect. It is claimed by the makers, the Moloney Electric Company, of St. Louis, that they unite with close regulation, high efficiency and the smallest losses, both in the copper and iron, that can commercially be produced. In addition to this particular care is given to the insulation of the working coils and the whole instrument is put together in a solid and mechanical fashion, insuring it from accidental damage and tending to long life and inexpensive maintenance.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, East Pittsburgh, Pa., has recently issued a very handsome book describing its electric locomotives for mine haulage. The Westinghouse company in building these locomotives acts in connection with the Baldwin Locomotive Works and the product is the result of their combined genius. The book in question is a handsome 75-page catalogue, profusely illustrated with fine half-tones and fully maintaining the excellent reputation for good work established by the Westinghouse companies' publishing department. The book is of particular interest to mining engineers and will be mailed upon application to the company.

THE OLDS MOTOR WORKS, Detroit, Mich., announces that although its factory was seriously crippled by fire on March 9 it will be only about 30 days behind in the fulfillment of its automobile orders, as all the patterns and drawings were saved, together with large quantities of material in the company's warehouses, which were not destroyed. The Lansing plant, by running day and night, will be able to take care of all orders for gasoline engines, and the company expects by the last of April to have a capacity of 10 completed automobiles per day. At the present time the company has orders for 334 Oldsmobile gasoline runabouts booked and these will be taken care of within the next two months so that orders for May delivery can now be cared for.